IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor:	Isaac LEVANON *et al.*
Asignee:	3VDU, Inc.
Serial No.:	10/035,981
Filed:	December 24, 2001
Title:	System And Methods of Network Image Delivery...
Examiner:	Philip B. Tran
Group:	2155
Confirmation No.:	3619
Attorney Docket:	927/2

This is submitted in response to the Office Action of March 17 2006.

Declaration of Inventors

Applicants Isaac Levanon and Yoni Lavi being duly sworn, depose and affirm that:

1. We hereby declare that we believe we are the original, first and co-inventors of the subject matter which is claimed herein for which a utility patent is sought on the invention described and claimed in the above-identified application; that we have reviewed and understand the contents of the application, including the claims; and, that we acknowledge our duty to disclose to the PTO information of which we are aware which is material to patentability of this invention as defined in 37 C.F.R. 1.56.

2. The invention as claimed in independent claims 1, 7, 12 and 16 was first defined on paper in October 1999 and reduced to practice by a working computer program in December 1999.

It is established that a working product was in applicant's position by 24 January 2000 in view of the Website presentation evidenced by the screens shots of Exhibit A as filed in Affidavit of 10 January 2006.

Independent claims 1, 7, 12 and 16 are reproduced hereinbelow with part annotations a, b, c, d, e...added, for ease of referencing to the various components:

Claim 1 relates to a client system for dynamic visualization of image data provided through a network communications channel, said client system comprising:

(a) a parcel request subsystem, including a parcel request queue, operative to request discrete image data parcels in a priority order and to store received image data parcels in a parcel data store, said parcel request subsystem being responsive to an image parcel request of assigned priority to place said image parcel request in said parcel request queue ordered in correspondence with said assigned priority; and

(b) an parcel rendering subsystem coupled to said parcel data store to selectively retrieve and render received image data parcels to a display memory, said parcel rendering system providing said parcel request subsystem with said image parcel request of said assigned priority.

Applicant affirms that the parcel request subsystem and the parcel rendering subsystem were reduced to practice by 24 January 2000.

A copy of archived source code, substantially identical to that of the version of January 2000 is appended herewith. This source code shows how the invention was reduced to practice by being programmed into a working system implementation and is proof of Reduction To Practice in that it demonstrates that the claimed invention was programmed and worked. Applicants affirm that the code is substantially that of the version of December 1999.

Specifically, the "Parcel Request Subsystem" (a) consists of multiple consumers, and a single producer. The function "DLDownloaderThread" is executed from four threads running in parallel to the main program (See "DLStartDownloaderThreads" and "DLStopDownloaderThreads"). Each of those threads acts as a consumer of the "Parcel Request Queue". The priority queue is implemented over a stack of sorted items named "DTL". The consumers extract items from the top of the stack. The main program acts as

a producer of parcel requests. The function to consume requests from the queue is named DLGetNext.

The function "RenderQuads", in addition to rendering the visible images parcels on the display, also creates requests for parcels that are needed, and evaluates the priority of each request as described in the patent, using function DLAdd. The function DLManager places these requests inside an array, sorts it by priority and replaces the previous stack (Parcel request queue) with the contents of the sorted array.

The priority computation in function DLAdd is performed according to the priority evaluation method explained in the patent application, see paragraphs 59-69 thereof.

The function GenerateTileOffset computes the offset of each requested parcel inside the "Parcel data store" described by the patent. There is an explicit assumption of 2KB per compressed parcel in the data store, possible through use of a fixed-rate compression, which makes the implementation very simple.

The producer side of the Parcel Request Subsystem (explained earlier) in effect shows implementation of *parcel rendering subsystem* (b).

This is also supported by the following routines and functions: DLAdd, DLReset, GenerateOffsetTable, GenerateTileOffset
, PolygonSurface, Distort, Http11Request ,TileManagerRender RecalcTilePlane DrawTileMap, TexelDensity, TileGetDrawlevel, Fast_WithinFrustrum, QuadMake, RenderQuads, FrustrumClipper,

All functions in modules Raster.cppand Tex.cpp

Claim 7 relates to a portable display client system supporting dynamic visualization of image data provided through a wireless network communications channel, said client system comprising:

(c) a display of defined resolution suitable for visual presentation of a graphical image, said display including video memory for storing image data representative of said graphical image;

(d) a network interface coupleable to a wireless network through which

to request and receive image data parcels;

(e) an image parcel data store providing for the storage of image data parcels;

(f) navigation controls providing input information defining a point of view location relative to said graphical image; and

(g) a processor coupled to said video memory, network interface, image parcel data store, and navigational controls, said processor operative to selectively request image data parcels of determined resolution through said network interface in a priority order computed relative to the defined resolution of said display.

Applicant asserts that the invention of claim 7 was reduced to practice in December 1999. All components related to in claim 7 were implemented in the software prior to January 2000. Fragments of source code given herewithin show this implementation.

The display of defined resolution suitable for visual presentation of a graphical image (c) is supported by the FlipWindow function.

The Network interface (d) is utilized by the function Http11Request, which is used to retrieve image parcels through the HTTP/1.1 protocol.

The function "Dynamic_Camera" implements various navigation commands which respond to various keystrokes. This supports (f) *the navigation controls providing input information defining a point of view location relative to said graphical image.*

The hardware specified in (c), (e), (g) by virtue of being hardware, cannot be directly shown in any source code of course. Nevertheless, evidence that these components were available in January 2000 is given through inference and via the OS API and runtime library calls. As evidenced by calls to functions such as GetAsyncKeyState, BitBlt and socket, the program interacted with these hardware elements, available in January 2000 and described in the provisional patent specification filed in December of that year.

Claim 12 relates to a client system providing for the three-dimensional viewing of an image relative to a dynamic viewpoint, said client system comprising:

(h) display memory corresponding to a two-dimensional display of defined resolution;

(i) a network interface through which image data parcels of respective image parcel resolution can be requested and received;

(j) navigational controls providing for the definition of an image viewpoint; and

(k) a processor operative to progressively render image data parcels into said display memory and to progressively request image data parcels through said network interface in a priority order determined with respect to the defined resolution of said two dimensional display and the location of said image viewpoint.

Applicant asserts that the invention of claim 12 was similarly reduced to practice by December 1999.

(h) is evidenced by InitDevice and FlipWindow

Further evidence that these components were available in January 2000 is given through inference and via the OS API and runtime library calls. As evidenced by calls to functions such as GetAsyncKeyState, BitBlt and socket, the program interacted with these hardware elements, available in January 2000 and described in the provisional patent specification filed in December of that year.

The Network interface (i) is utilized by the function Http11Request, which is used to retrieve image parcels through the HTTP/1.1 protocol.

The *navigation controls providing input information defining a point of view location relative to said graphical image* (j) are supported by the function "Dynamic_Camera" which implements various navigation commands in response to various keystrokes.

The hardware specified in (k), by virtue of being hardware, cannot be directly shown in any source code.

We afirm that all components related to in claim 12 were implemented in the software by 24 June 2000. The fragments of source code given hereabove support this afirmation.

Claim 16 relates to a method of supporting dynamic visualization of image data transferred through a communications channel, said method comprising the steps of:
(l) determining, in response to user navigational commands, a viewpoint orientation with respect to an image displayed within a three-dimensional space;
(m) requesting, in a priority order, image parcels renderable as corresponding regions of said image, each said image parcel having an associated resolution, wherein said priority order is determined to provide a progressive regional resolution enhancement of said image as each said image parcel is rendered;
(n) receiving a plurality of image parcels through said communications channel; and
(o) rendering said plurality of image parcels to provide said image.

(l) is supported by the function "Dynamic_Camera" which implements various navigation commands which respond to various keystrokes,

(m) is implemented in the producer side of the Parcel Request Subsystem, by functions including:
DLAdd, DLReset, GenerateOffsetTable, GenerateTileOffset, , PolygonSurface, Distort, Http11Request

(n) is implemented in the function Http11Request, which is used to retrieve image parcels through the HTTP/1.1 protocol

See also DLReceive which processes the output from the Parcel Request Subsytem, creating a 64 by 64 texture map by applying the image decoder on the received data block, using the function DecodeFxt1. The FXT1 texture compression format has a fixed rate compression of 4 bits per pixel, yielding 2KB of data per each compressed 64 by 64 image parcel. This matches the compression rate for parcels specified in the patent application.

(o) is implemented by the functions "TileManagerRender" and its subroutines ("DrawTileMap", "QuadMake" "RenderQuads", "Fast_WithinFrustrum", "SpliceVertex", "FrustrumClipper" among others) which render the image data to the system display. See alsoTileRecalcPlane, TexelDensity, TileGetDrawlevel, All functions in modules Raster.cpp and Tex.cpp

Applicant asserts that all components related to in claims 1, 7, 12, 16 were implemented in the software in December 1999, prior to publishing of the Website Presentation on the Internet as shown by Exhibit B.

As evidenced by Exhibit C, GA Central Executive Summary (appended herewithin as Exhibit Ci) was written up by 20 March 2000 and Power Point Presentation GA Central2.ppt (Exhibit Cii) was written up by 13 May 2000. These documents provide further proof that the working system, including code appended hereto, were in applicant's position prior to the filing date of US 6,671,424 to Skoll, which was filed in July 2000.

Exhibit D is a screen shot extracted from Exhibit Cii, which, as evidenced by Exhibit C, was written on or before 13 May 2000. Applicant affirms that the screen shot shown in Exhibit C was obtained by running the program that embodies the invention as claimed in claims 1, 7, 12 and 16, back in December 1999. This supports Applicant's claim that the invention as shown in source code appended herewith was in their posession in December 1999 which is six months prior to the filing date of US 6,671,424 to Skoll, which was filed in July 2000.

Exhibit E and G are screen captures from December 1999 that shows that the program whose source code is appended herewith was indeed up and running at that time.

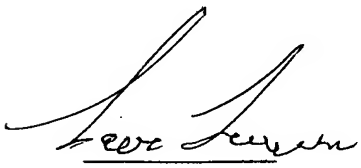
It will be noted that although the code appended may have been minorly revised during maintenance, and may not perfectly match the initial implementation however it shows that the present invention as claimed was indeed reduced to practice.

Applicant has thus demonstrated that the invention as claimed in claims 1, 7, 12 and 16 was reduced to practice prior to July 2000 and respectfully submits that US 6,671,424 Skoll, which was filed in July 2000, is not prior art to these claims.

If claims 1, 7, 12 and 16 are inventive, then dependent claims 2-6, 8 to 11 and 17 to 20 are inventive as well. We respectfully submit that claims 1 to 11 and 16 to 20 are thus allowable, and request that Examiner withdraws his objections of March 17 2006 and allows the claim set of USSN 10/035,981 as filed.

3. The evidence submitted is sufficient to establish a reduction to practice of the invention in the US or a NAFTA or WTO member country prior to the effective date of the Robotham reference.

4. We hereby declare that all statements made herein are of our own knowledge and are true. All statements made on information and belief are believed to be true. All statements are made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the Unites States Code and that such willful statements may jeopardize the validity of the application or any patent issued thereon.



Isaac Levanon

Yoni Lavi

Dated: June 13, 2006

EXHIBITS

EXHIBIT A

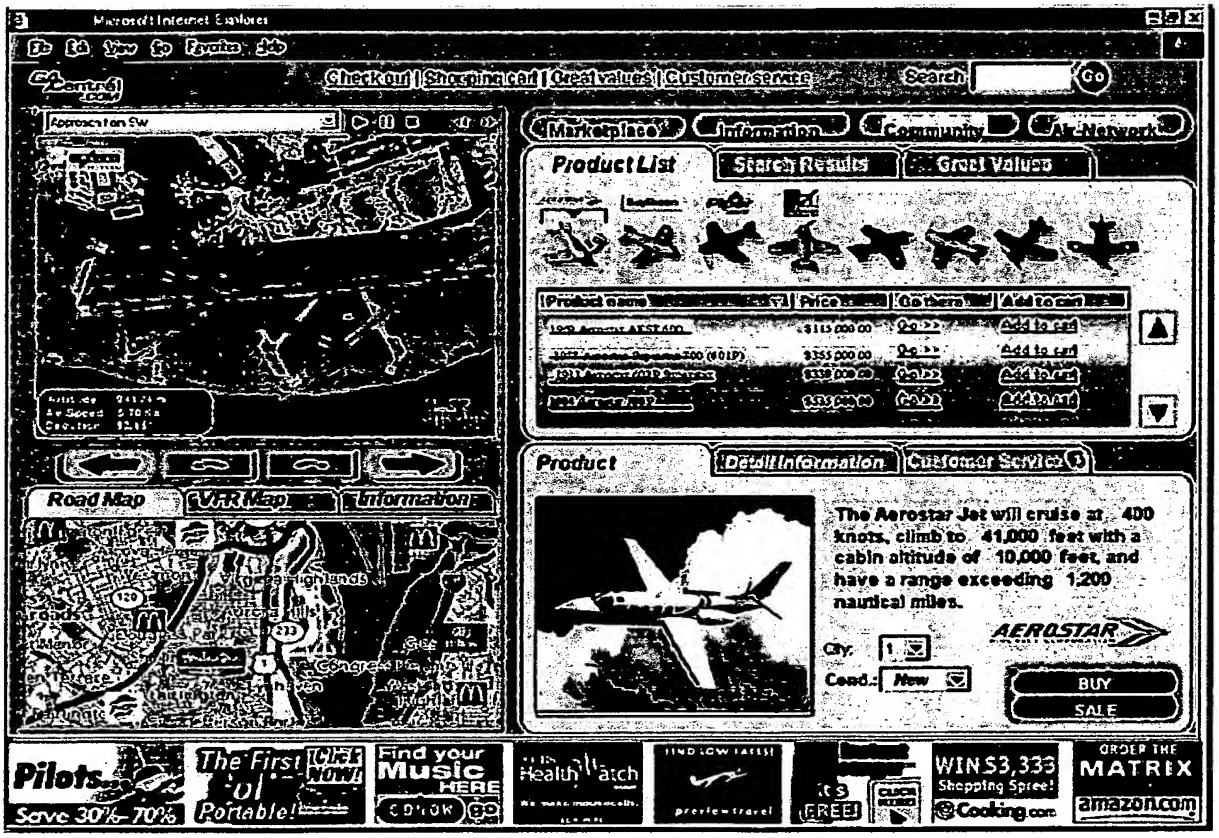


Exhibit B

Web Site Presentation

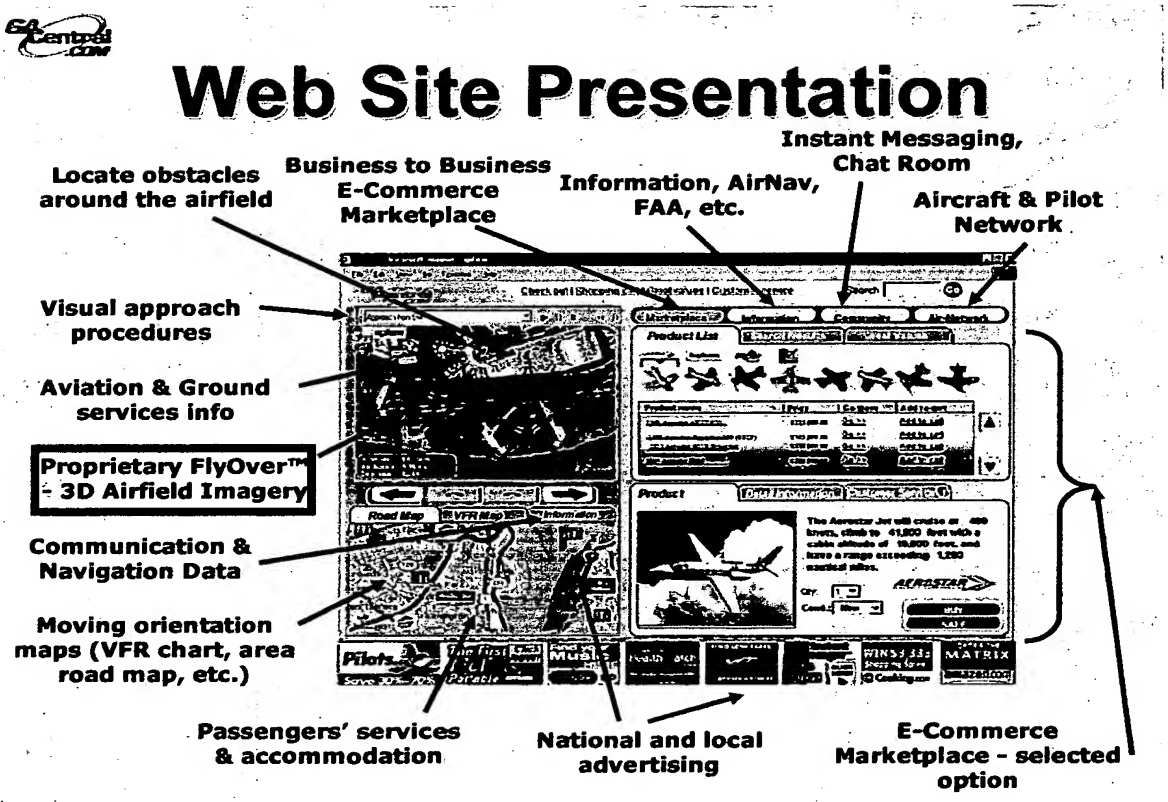
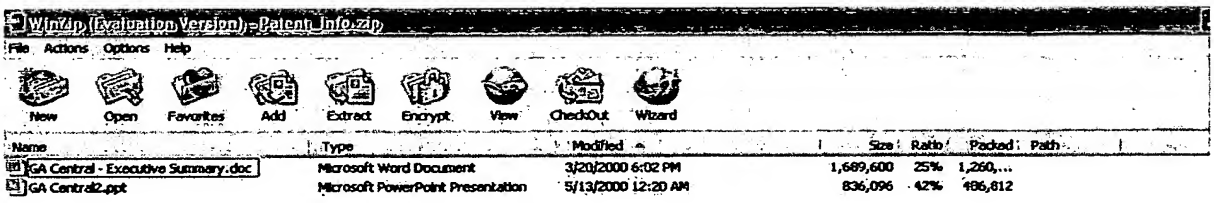


Exhibit C



Name	Type	Modified	Size
GA Central – Executive Summary.doc	Microsoft Word Document	3/20/2000 6:02 PM	1,689,600
GA Central2.ppt	Microsoft PowerPoint Presentation	5/13/2000 12:20 AM	836,096

Exhibit D

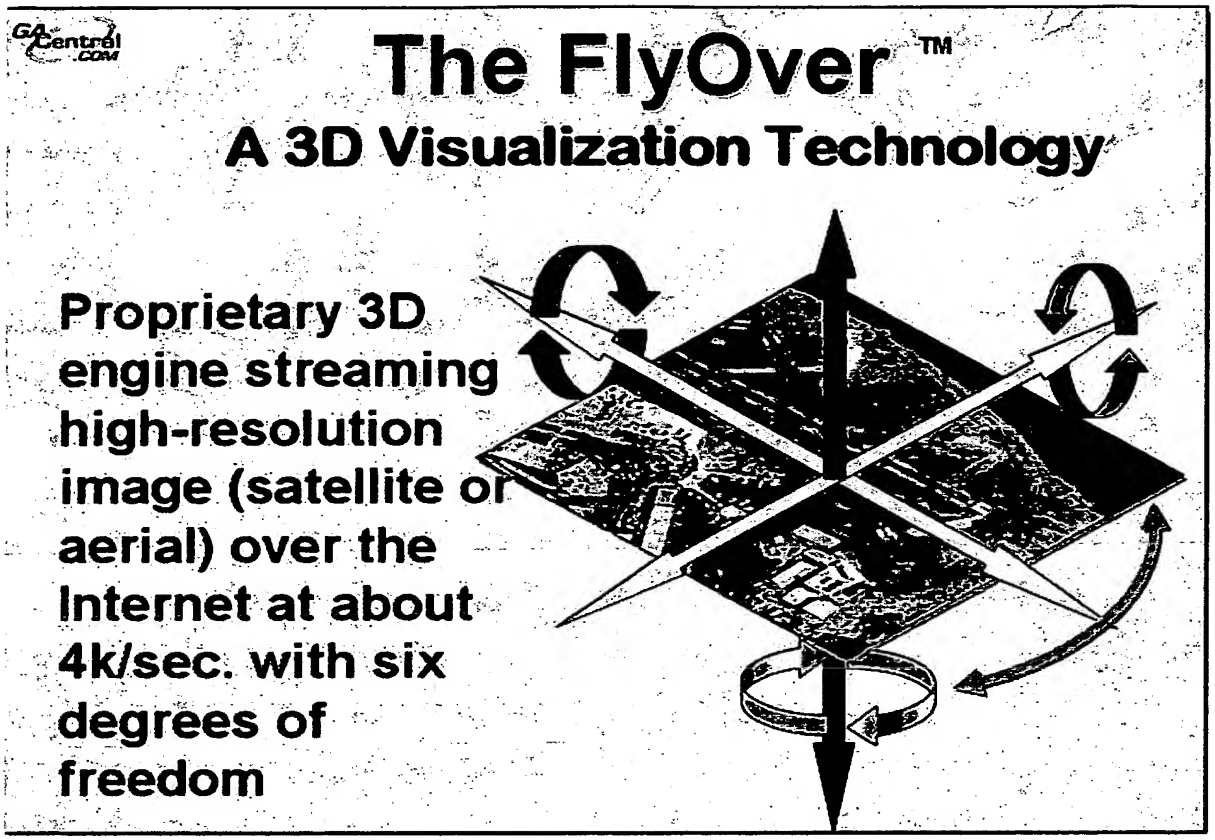

GA Central .com
The FlyOver ™
A 3D Visualization Technology
Proprietary 3D engine streaming high-resolution image (satellite or aerial) over the Internet at about 4k/sec. with six degrees of freedom

Exhibit E

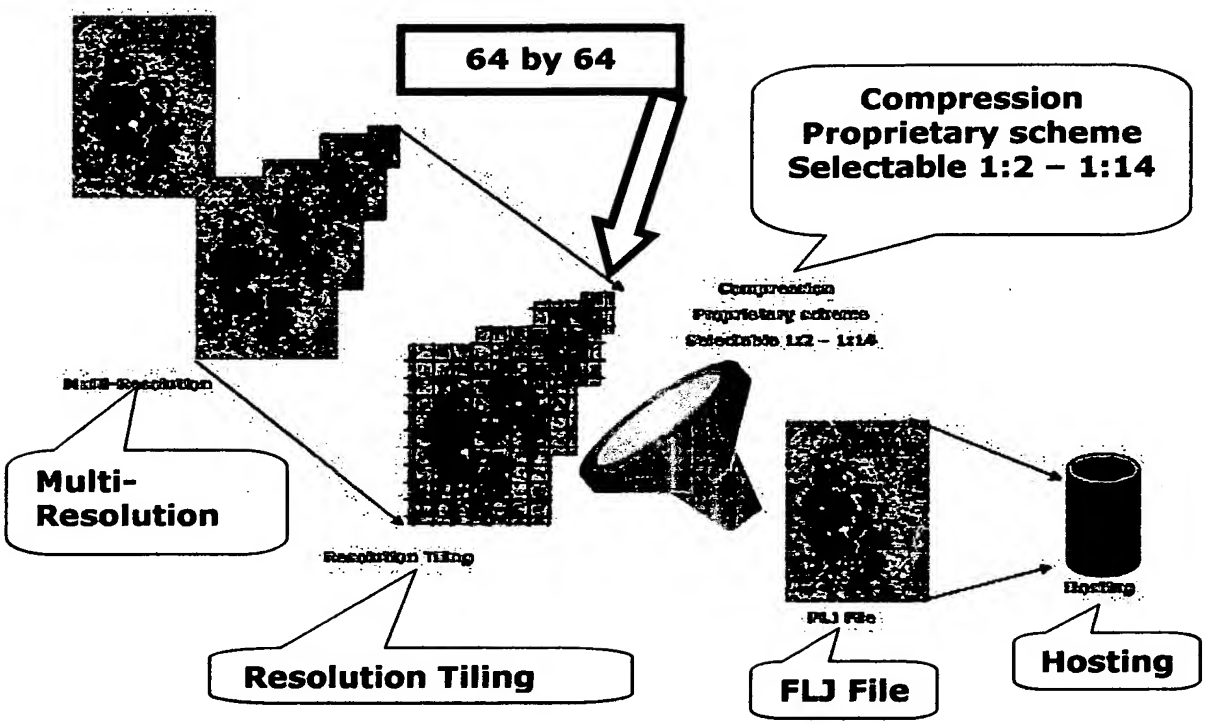

64 by 64
Compression
Proprietary scheme
Selectable 1:2 – 1:14
Multi-
Resolution
Resolution Tiling
FLJ File
Hosting

Exhibit F

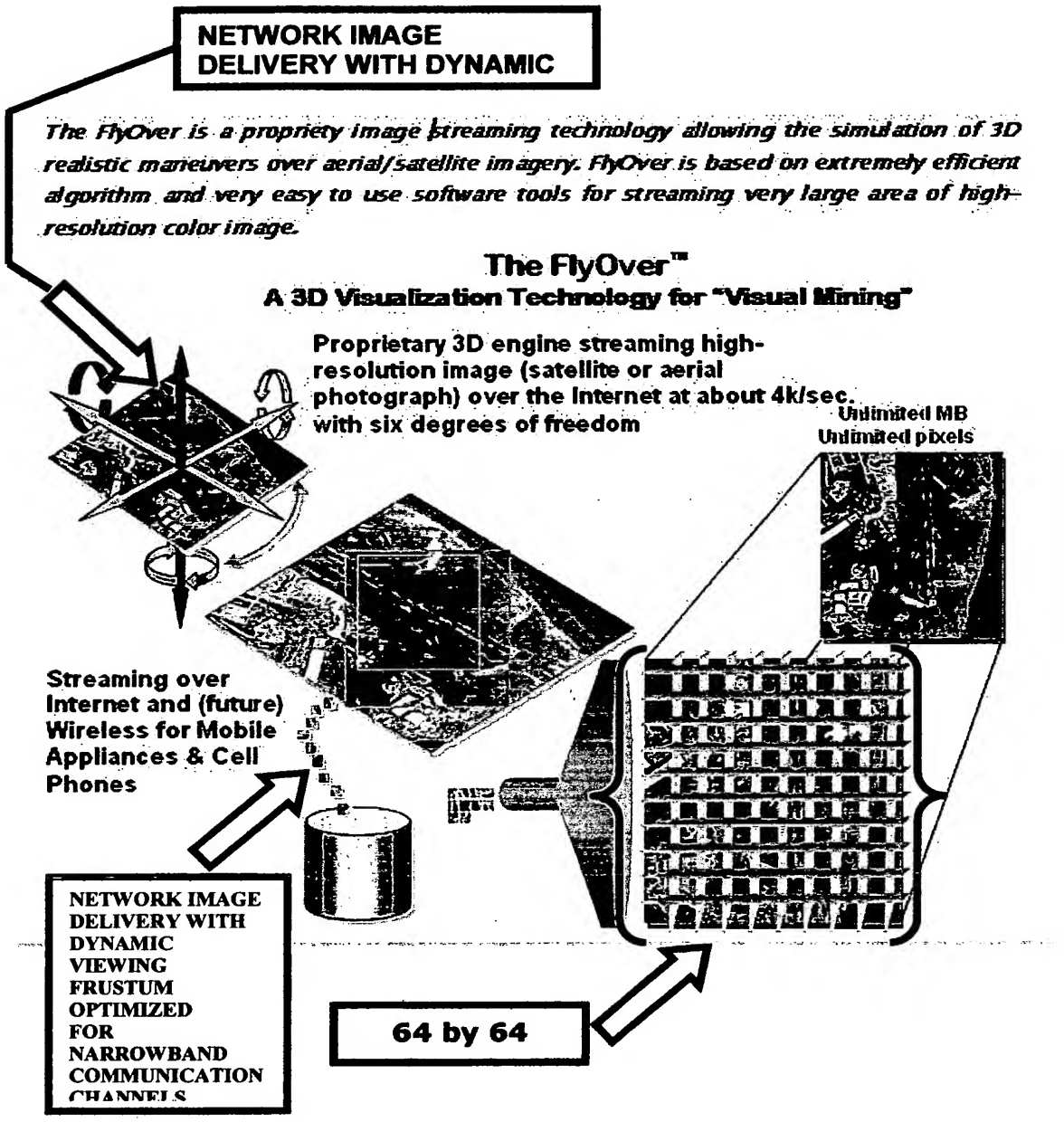

NETWORK IMAGE DELIVERY WITH DYNAMIC
The FlyOver is a propriety image streaming technology allowing the simulation of 3D realistic maneuvers over aerial/satellite imagery. FlyOver is based on extremely efficient algorithm and very easy to use software tools for streaming very large area of high-resolution color image.
The FlyOver™
A 3D Visualization Technology for "Visual Mining"
Proprietary 3D engine streaming high-resolution image (satellite or aerial photograph) over the Internet at about 4k/sec. with six degrees of freedom
Unlimited MB
Unlimited pixels
Streaming over Internet and (future) Wireless for Mobile Appliances & Cell Phones
NETWORK IMAGE DELIVERY WITH DYNAMIC VIEWING FRUSTUM OPTIMIZED FOR NARROWBAND COMMUNICATION CHANNELS
64 by 64

Exhibit G

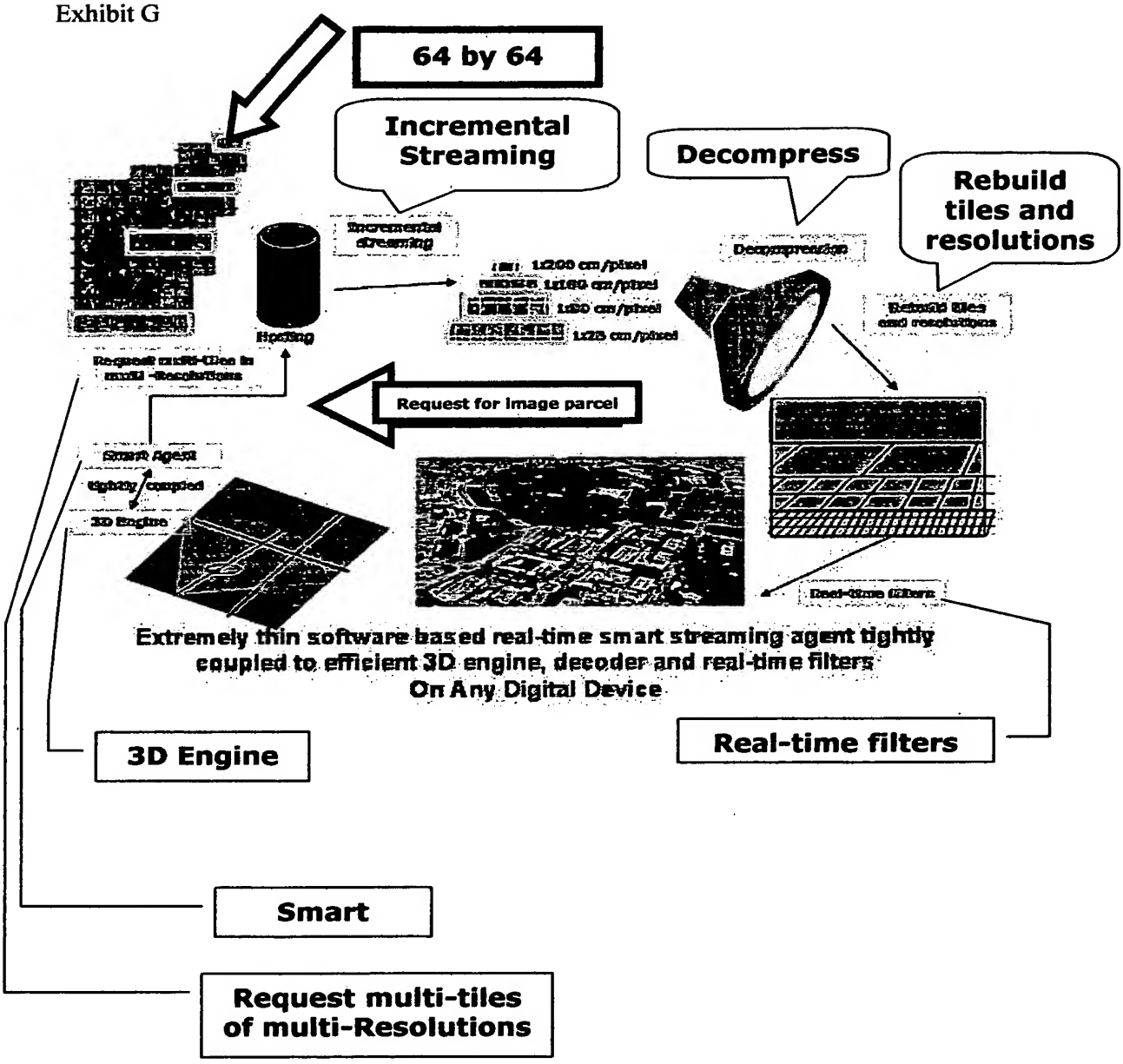

64 by 64
Incremental Streaming
Decompress
Rebuild tiles and resolutions
Request for image parcel
Extremely thin software based real-time smart streaming agent tightly coupled to efficient 3D engine, decoder and real-time filters On Any Digital Device
3D Engine
Real-time filters
Smart
Request multi-tiles of multi-Resolutions

Exhibit H

Image 1

Image2

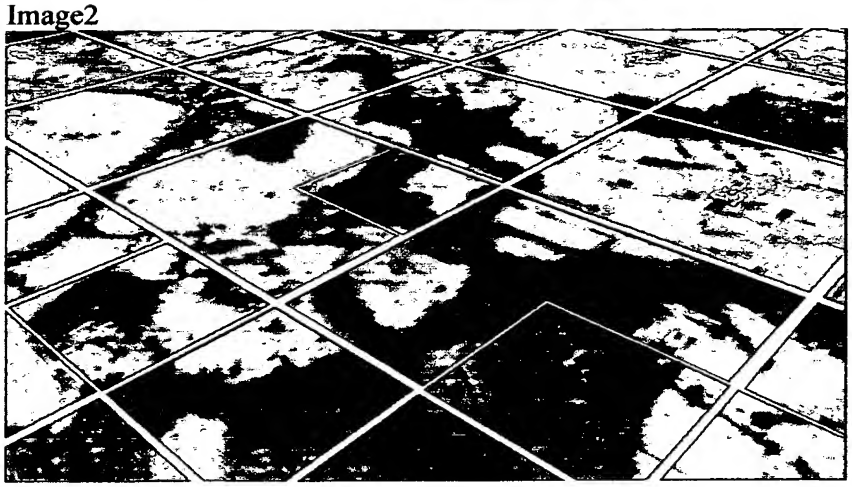


Exhibit H continued

Image 3

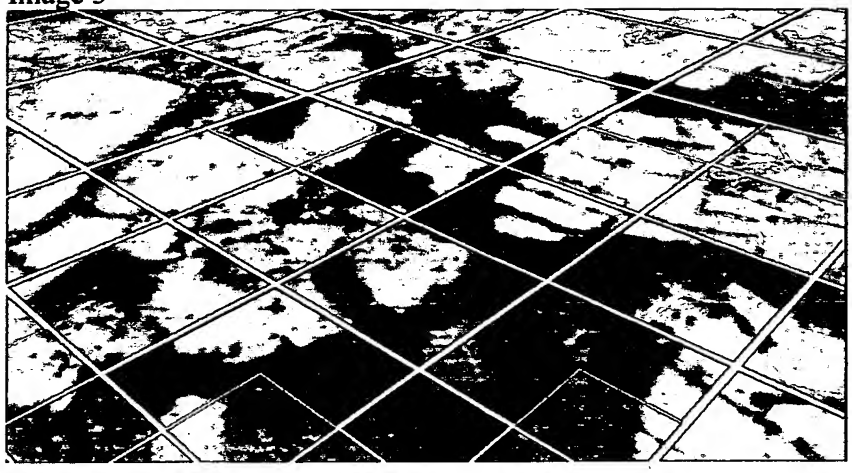
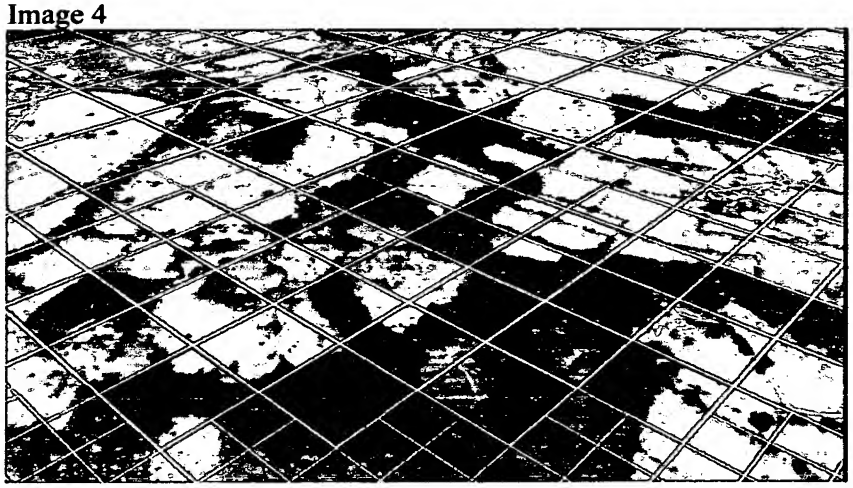


Image 4



APPENDIX (I)

Source code listing

Module: MapTiles.cpp

```
// Download recieve: this is called by the Downloader
threads when they finish downloading
// one of the map tiles. It decodes the FXT1 image and
generates a texture which is
// inserted to the texture cache.
void DLRecieve(MapTile *MT, byte *pBuf)
{
     Image *Img = new Image;

     DecodeFxt1(pBuf, Img);

     if (!Img->pData)
     {
          printf("*** ARPA ALARMS: Failed to D/L texture
from map server\n");
          return;
     }

     if ((Img->xRes> g_TM.TileSize)||
          (Img->yRes > g_TM.TileSize))
     {
          printf("*** ARPA ALARMS: Downloaded image is too
large (incorrect TM setup?)\n");
          //return;
     }

     if ((Img->xRes< g_TM.TileSize)||
          (Img->yRes < g_TM.TileSize))
     {
          ImagePadding(Img);
     }

#ifndef _FLY_OVER_WIN_CE
     __MAPPER__Tile4(Img); // ??? if i want to use the ref-
resterizer put this line remark. and hit R
#endif

     // before removing eyal+gilad memory trick

               /*   word *w = new word[64*64*5];
                    //memcpy(w        ,Img-
>pData,sizeof(word)*64*64);
```

```
                    memcpy(w+64*64*4,Img-
>pData,sizeof(word)*64*64);
                    DWORD I;
                    for(I=0;I<64;I++)
                         memcpy(w+256*I,Img-
>pData+64*I,sizeof(word)*64);

                    delete Img->pData;

                    Img->pData=w;
                    // Texture -> 256x64
                    //__MAPPER_ImagePadding(Img);
                    //__MAPPER_Align64(Img);

                    Img->pData += 64*64*4;
                    __MAPPER__Tile4(Img);
                    Img->pData -= 64*64*4;*/

     // end - before removing eyal+gilad memory trick

     // tiling shit
     TTexStorage_Add(MT,Img->pData);
     delete Img;
     //Insert2TCache(MT,Img->pData);
     //delete Img->pData;
     //MT->Texture = Img; //SYNCED! so engine wont try to
use a non-padded texture
/*   if (MT->Flags & MT_JIT)
     {
          int wtf = 1;
     }*/

     //MT->Flags &= ~MT_Downloading;
}

// Resets the download request list
static void DLReset()
{
     dword i;
     for(i=0;i<g_TM.DLNumRequests;++i)
     {
          g_TM.DLRequests[i].MT->DR = NULL;
     }
     g_TM.DLNumRequests = 0;
}
```

```
// Garage Operation. (Calculates offsets inside map tile
master index file)
static void GenerateOffsetTable()
{
     // BASE OFFSET: 1K
     const dword BASE_OFFS = 1024;
     // IMAGE CELL SIZE (TSxTSx16bit using FXT1): 4bit *
TS^2
     const dword BASE_HEADER = 16;
     g_TM.IMAGE_CELL_SIZE =
((g_TM.TileSize*g_TM.TileSize)>>1)+BASE_HEADER;

     dword I,OFFS = BASE_OFFS;

     for(I=0;I<g_TM.MaxLevel;I++)
     {
          // LEVEL OFFSET: #Tiles(T|Lvl(T)=L) *
IMAGECELLSIZE
          dword S = g_TM.TSize[I];
          dword X = (g_TM.XSize+S-1)/S; //divide + round up
          dword Y = (g_TM.YSize+S-1)/S; //divide + round up
          g_TM.XTiles[I] = X;
          g_TM.Offs[I] = OFFS;

          OFFS += X*Y*g_TM.IMAGE_CELL_SIZE;
     }
}

// calculates offset inside map tile master index file,
given the Texture's level and
// (X,Y) in that level's tile grid.
static dword GenerateTileOffset(dword Level,dword X,dword
Y)
{
     return g_TM.Offs[Level] + (X + Y *
g_TM.XTiles[Level])*g_TM.IMAGE_CELL_SIZE;
}

// Distorts coordinates to create the fisheye effect needed
for prioritizing
// cells at the view's center (focus) over peripheral
regions
// dfactor: distortion factor [0,1]. dfactor=1 has no
distortion effect
static inline float Distort(float x,float dfactor = 0.35)
{
     if (x>0)
```

```
    {
        return (float)pow(x,dfactor);
    } else {
        return -(float)pow(-x,dfactor);
    }
    return 0.0;
}

// Computes the surface of the polygon currently stored in
the frustrum clipper
// can work either pre or post clipping
static float PolygonSurface()
{
    long i;
    float s = 0.0f;
    Vertex *A,*C;
    A = C_Prim[0];

    float ax = Distort(A->PX / (float)(g_xRes*0.5f) -
1.0f),
          ay = Distort(A->PY / (float)(g_yRes*0.5f) -
1.0f);
    C = C_Prim[1];
    float cx = Distort(C->PX / (float)(g_xRes*0.5f) -
1.0f),
          cy = Distort(C->PY / (float)(g_yRes*0.5f) -
1.0f);
    float bx,by;
    for(i=2;i<C_NumVtx;++i)
    {
        bx = cx;
        by = cy;
        C = C_Prim[i];
        cx = Distort(C->PX / (float)(g_xRes*0.5f) -
1.0f);
        cy = Distort(C->PY / (float)(g_yRes*0.5f) -
1.0f);
        s += (ax * by - bx * ay) +
             (cx * ay - ax * cy) +
             (bx * cy - cx * by);
    }
    return (float)fabs(s);
}

// Add maptile to the list of requested downloads.
// DLev (Draw level) is used to determine the priority of
the request.
```

```
// Draw level should be the texture detail level in which
the map tile would have
// been drawn if all the textures were available
(mipmapping limit)
static void DLAdd(Quad *Q,MapTile *MT)
{
     long DLev = Q->drawlev;
/*   if (!MT)
     {
          int gagaga=1;
     }*/
     if (MT->Flags&MT_Downloading) return; //I know all
about the Zerg, Gerard.

     dword I;
     if (MT->DR) {
          I = MT->DR - g_TM.DLRequests;
     } else {
          if (g_TM.DLNumRequests==g_TM.DLMaxRequests)
          {
               g_TM.DLMaxRequests+=DLMaxInitialRequests;
               g_TM.DLRequests = (DownloadRequest
*)realloc(g_TM.DLRequests,g_TM.DLMaxRequests*sizeof(Downloa
dRequest));
          }
          I = g_TM.DLNumRequests++;
          g_TM.DLRequests[I].MT = MT;
          g_TM.DLRequests[I].FOffset =
GenerateTileOffset(MT->Level,MT->TX,MT->TY);
          g_TM.DLRequests[I].Priority = 0;
          MT->DR = g_TM.DLRequests+I;
     }

     //GenerateTileFilename(g_TM.DLRequests[I].Name,MT-
>Level,MT->TX,MT->TY);
/*   if (MT->Level==4)
     {
          int debug_me_now = 1;

     }*/

     //g_TM.DLRequests[I].Priority = 128+MT->Level*2-DLev;
     g_TM.DLRequests[I].Priority += PolygonSurface(); // *
(1<<((DLev-MT->Level) << 1));
}
```

```
// Creates child nodes for parameter maptile. This is
called whenever the tile
// has a draw level greater than its own level. [and its
own texture is available]
static dword MapTileExpand(MapTile *MT)
{
     if (MT->Flags&MT_Expanded) return 1; //already
expanded
     if (!MT->Texture) return 0; // no texture recieved yet

     MT->Flags|=MT_Expanded;
     dword Level = MT->Level+1;

     if (Level==g_TM.MaxLevel) return 1;

     dword xE = MT->X+g_TM.TSize[Level];
     dword yE = MT->Y+g_TM.TSize[Level];
     dword xOK = xE<g_TM.XSize;
     dword yOK = yE<g_TM.YSize;

     MT->M00 = new MapTile;
     memset(MT->M00,0,sizeof(MapTile));
     MT->M00->Level = Level;
     MT->M00->X = MT->X;
     MT->M00->Y = MT->Y;
     MT->M00->TX = MT->TX<<1;
     MT->M00->TY = MT->TY<<1;
     MT->M00->Parent = MT;

     if (xOK)
     {
          MT->M01 = new MapTile;
          memset(MT->M01,0,sizeof(MapTile));
          MT->M01->Level = Level;
          MT->M01->X = xE;
          MT->M01->Y = MT->Y;
          MT->M01->TX = (MT->TX<<1)+1;
          MT->M01->TY = MT->TY<<1;
          MT->M01->Parent = MT;
     }

     if (yOK)
     {
          MT->M10 = new MapTile;
          memset(MT->M10,0,sizeof(MapTile));
          MT->M10->Level = Level;
```

```
            MT->M10->X = MT->X;
            MT->M10->Y = yE;
            MT->M10->TX = MT->TX<<1;
            MT->M10->TY = (MT->TY<<1)+1;
            MT->M10->Parent = MT;
      }

      if (xOK&&yOK)
      {
            MT->M11 = new MapTile;
            memset(MT->M11,0,sizeof(MapTile));
            MT->M11->Level = Level;
            MT->M11->X = xE;
            MT->M11->Y = yE;
            MT->M11->TX = (MT->TX<<1)+1;
            MT->M11->TY = (MT->TY<<1)+1;
            MT->M11->Parent = MT;
      }

      return 1;
}

// should be called for each frame. determines the plane
equation
// of the map, transformed to camera space.
void TileRecalcPlane()
{
      // fundamental information: in world coordinates,
      // Origin is always at (0,0,0), the normal is always
(0,1,0)
      // XAxis is (1,0,0) and YAxis is (0,0,1).


      // Note! Image is inverted on the Y Axis, so Origin is
shifted and axis is flipped

      Vector3 U;
      float *VM = g_TM.Cm->VM;
      // calculate new origin
      VectorScale(&g_TM.Cm->Position,-1.0f,&U);
      MatrixXVector(VM,&U,&g_TM.Origin);

      // calcuate new axes
      VectorMake(&g_TM.XAxis,VM[0],VM[3],VM[6]); // VM *
(1,0,0)
      VectorMake(&g_TM.Norm ,VM[1],VM[4],VM[7]); // VM *
(0,1,0)
```

```
     VectorMake(&g_TM.YAxis,-VM[2],-VM[5],-VM[8]); // VM *
(0,0,1)

     VectorSelfScale(&g_TM.XAxis,g_TM.TexelSize);
     VectorSelfScale(&g_TM.YAxis,g_TM.TexelSize);
     VectorScale(&g_TM.YAxis,-
(float)g_TM.YSize,&U);//g_TM.TSize[0]
     VectorSelfAdd(&g_TM.Origin,&U);

     g_TM.PO =-VectorDot(&g_TM.Norm,&g_TM.Origin);
}

// Determines the size one map texel at location (x1,y1) on
the map has on the display after projection
float TexelDensity(float x1,float y1)
{
     Vector3 V;
     VectorMake(&V,g_TM.Origin.x + x1 * g_TM.XAxis.x + y1 *
g_TM.YAxis.x,
                      g_TM.Origin.y + x1 * g_TM.XAxis.y +
y1 * g_TM.YAxis.y,
                      g_TM.Origin.z + x1 * g_TM.XAxis.z +
y1 * g_TM.YAxis.z);

     float z = V.z*g_TM.TileSize/g_TM.TSize[0];
     float z2 = z*z;
     VectorNorm(&V);
     float ca = -VectorDot(&g_TM.Norm,&V);

     return g_TM.Cm->VP->Mipfactor * ca / z2;
}

// efficient Log2 operation on 32bit float (single
precision) type
long Log2(float x)
{
     long dwrep = *(long *)(&x);
     long exponent = (dwrep>>23)-127;

     return exponent;
}

// returns highest mipmapping level on a transformed
Quadritheral,
// Sucks. should be based on pix/tex Area ratio computation
void TileGetDrawlevel(MapTile *MT,dword *h)
{
```

```
     // calculate camera [x,y] on tile plane coordinate
     float ratio =-1.0f/(g_TM.TexelSize*g_TM.TexelSize);
     long cx =
(long)(ratio*VectorDot(&g_TM.Origin,&g_TM.XAxis));
     long cy =
(long)(ratio*VectorDot(&g_TM.Origin,&g_TM.YAxis));

     long x1 = MT->X;
     long y1 = MT->Y;

     long x2 = MT->X+g_TM.TSize[MT->Level];
     long y2 = MT->Y+g_TM.TSize[MT->Level];

     if (cx<x1) cx = x1;
     else if (cx>x2) cx = x2;

     if (cy<y1) cy = y1;
     else if (cy>y2) cy = y2;

     // Nearest (x1,y1) Furthest (x2,y2)
     long lvl = Log2(TexelDensity((float)cx,(float)cy))>>1;
// log4(dens)
     long sl = lvl>=(long)g_TM.MaxLevel ? g_TM.MaxLevel-1 :
lvl;
     *h = sl>0 ? sl : 0;
}

// This is a recoursive function which builds up the
Rendering information.
// Either it recourses or calls QuadMake, thus rendering
the entire visible
// portion of the map.
void DrawTileMap(MapTile *MT,Vector3 *A,Vector3 *B,Vector3
*C,Vector3 *D)
{
     dword high;
     TileGetDrawlevel(MT,&high);
     // LA-Z-Eval: if high>MT->Level, maptileexpand will be
called,
     // and if failed, entire quad will be drawn without
expanding
     if (high<=MT->Level||(!MapTileExpand(MT)))
     {
          //if (high>MT->Level) high=MT->Level;
          // draw Tile as a Quad
          float xFrac = 1.0f,yFrac = 1.0f;
          if (MT->X+g_TM.TSize[MT->Level]>g_TM.XSize)
```

```
                xFrac = (float)(g_TM.XSize-MT-
>X)/(float)g_TM.TSize[MT->Level];
          if (MT->Y+g_TM.TSize[MT->Level]>g_TM.YSize)
                yFrac = (float)(g_TM.YSize-MT-
>Y)/(float)g_TM.TSize[MT->Level];

          QuadMake(high,MT,A,B,C,D,xFrac,yFrac);
          return;
     }

     Vector3 AB,BC,CD,DA,ABCD;
     VectorAvg(A,B,&AB);
     VectorAvg(B,C,&BC);
     VectorAvg(C,D,&CD);
     VectorAvg(D,A,&DA);
     VectorAvg(&AB,&CD,&ABCD);
     if (MT->M00) DrawTileMap(MT->M00,A,&AB,&ABCD,&DA);
     if (MT->M01) DrawTileMap(MT->M01,&AB,B,&BC,&ABCD);
     if (MT->M11) DrawTileMap(MT->M11,&ABCD,&BC,C,&CD);
     if (MT->M10) DrawTileMap(MT->M10,&DA,&ABCD,&CD,D);
}

// stores the ngon visible from frustrum on map
struct WF_Visible_NGon
{
     Vector2 VA[12];
     dword NumVtx;
};

WF_Visible_NGon FWF_;

// initializes the fast within-frustrum test routine
void Fast_WithinFrustrum_Init(Viewport *VP,Vector3 **V)
{
     // intersect entire region with viewport
     // by calling f-clipper on a generated poly
     // somehow remove the call to drawer
     // XFORM V
     Vertex VA[4];
     long i;
     for(i=0;i<4;i++)
     {
          VA[i].TPos.x = g_VP.CX * V[i]->z + g_VP.K * V[i]-
>x;
          VA[i].TPos.y = g_VP.CY * V[i]->z - g_VP.K * V[i]-
>y;
          VA[i].TPos.z = V[i]->z;
```

```
            VA[i].RZ = 1.0f/VA[i].TPos.z;
            VA[i].PX = VA[i].TPos.x * VA[i].RZ;
            VA[i].PY = VA[i].TPos.y * VA[i].RZ;
            VertexFlags(VA+i);
            C_Buf[i] = VA+i;
      }

      C_NumVtx = 4;

      C_Flags =
Vtx_Visibility&(VA[0].Flags|VA[1].Flags|VA[2].Flags|VA[3].F
lags);

      FrustrumClipper(NULL);

      // copy to FWF_
      FWF_.NumVtx = C_NumVtx;
      float rK = 1.0f/g_VP.K;
      for(dword I=0;I<C_NumVtx;I++)
      {
            //   memcpy(FWF_.VA+I,C_Prim[I],sizeof(Vertex));
            // Inverse-Transform perspective and 3d->map
coordinate
            Vector3 V;
            V.z = 1.0f/C_Prim[I]->RZ;
            float z = rK*V.z;
            V.x = (C_Prim[I]->PX-g_VP.CX)*z;
            V.y = (g_VP.CY-C_Prim[I]->PY)*z;
            //now V is a position in 3d[camera-space] (i
hope)

            VectorSelfSub(&V,&g_TM.Origin);
            FWF_.VA[I].x =
VectorDot(&V,&g_TM.XAxis)*g_TM.rTexelSize;
            FWF_.VA[I].y =
VectorDot(&V,&g_TM.YAxis)*g_TM.rTexelSize;
            //IFontWrite(IFNT_STD, 10, 50+20*I, "Delimiter
NGON (%f,%f)",FWF_.VA[I].x,FWF_.VA[I].y);
      }
      // complete cycle
      FWF_.VA[C_NumVtx].x = FWF_.VA[0].x;
      FWF_.VA[C_NumVtx].y = FWF_.VA[0].y;
}

dword Within_NGon(Vector2 *U)
{
      dword I,J=0;
```

```
	Vector2 n,d;
	for(I=0;I<FWF_.NumVtx;I++)
	{
		n.x = FWF_.VA[I  ].y - FWF_.VA[I+1].y;
		n.y = FWF_.VA[I+1].x - FWF_.VA[I  ].x;
		d.x = U->x-FWF_.VA[I].x;
		d.y = U->y-FWF_.VA[I].y;
		if (n.x*d.x+n.y*d.y<0.0f) J+=1<<I;
	}
	return J;
}

dword Fast_WithinFrustrum(MapTile *MT)
{
	// square:
	//MT->X,MT->Y : MT->X+g_TM.TSize[MT->Level],...
	// NGON is supposed to be CCW,so, at least one
	// of the points is supposed to be inside ngon
	// WRONG! this _has_ to clip the square vs the ngon
	// (arg) or reject squares that are all on the
negative
	// side of one of the edges of the ngon
	dword l = MT->Level;
	Vector2 U,V;
	V.x = (float)MT->X*g_TM.TexelSize;
	V.y = (float)MT->Y*g_TM.TexelSize;
	float edgelen = g_TM.TSize[l] * g_TM.TexelSize;
	dword f1,f2,f3,f4; // clipping flags
	if (!(f1=Within_NGon(&V))) return 1;
	U.x = V.x+edgelen;
	U.y = V.y;
	if (!(f2=Within_NGon(&U))) return 1;
	U.y += edgelen;
	if (!(f3=Within_NGon(&U))) return 1;
	U.x = V.x;
	if (!(f4=Within_NGon(&U))) return 1;
	return (!(f1&f2&f3&f4));
}

// Generates a Quadritheral for rendering. xFrac and yFrac
are used to build partial tiles.
inline void QuadMake(dword drawlevel,MapTile *MT,Vector3
*A,Vector3 *B,Vector3 *C,Vector3 *D,float xFrac,float
yFrac)
{
	// Verify the Quadritheral is within the viewing
frustrum.
```

```
     if (!Fast_WithinFrustrum(MT)) return;

     Quad *Q = QuadGet();
     Q->MT = MT;

     long texlevel = (drawlevel>MT->Level) ? MT->Level :
drawlevel;

     long leveldiff = MT->Level - texlevel;
     long levelpenalty;
     long i,j;

     MapTile *PMT = MT; // Parent Maptile

     for(i=0;i<leveldiff;++i) PMT = PMT->Parent;

     // Quad should use PMT's texture.
     // if it does not exist, we keep going up the tree
until we find a maptile with
     // a texture (root should always have a texture)
     while ((!PMT->Texture)||(PMT->Flags & MT_Downloading))
     {
          if (PMT->Parent)
          {
               PMT=PMT->Parent;
               ++leveldiff;
               --texlevel;
          } else {
               // Fatal Error: no texture available
               --NumQuads;
               return;
          }
     }

     // Calculate mapping coordinates
     float rdtex = 1.0f/g_TM.TSize[texlevel];

     float tl = 1.0f/((float)(1<<leveldiff));
     float u = (MT->X - PMT->X)*rdtex;
     float v = (MT->Y - PMT->Y)*rdtex;

     Vector3 Pos[4]; // Position vectors, scaled using
xFrac and yFrac
     VectorCopy(Pos  ,A);
     VectorCopy(Pos+1,B);
     VectorCopy(Pos+2,C);
     VectorCopy(Pos+3,D);
```

```
      VectorLERP(Pos+1,Pos  ,1.0f-xFrac);
      VectorLERP(Pos+2,Pos+3,1.0f-xFrac);
      VectorLERP(Pos+3,Pos  ,1.0f-yFrac);
      VectorLERP(Pos+2,Pos+1,1.0f-yFrac);


      Vertex *VA[4] = {&Q->A,&Q->B,&Q->C,&Q->D};
      Vertex *Vtx;
      Vector3 *V = Pos;
      // set up mapping coordinates
      float utl_ = xFrac * tl *(LEFTU/64.0f);
      float vtl_ = yFrac * tl *(LEFTU/64.0f);
      float utl = xFrac * tl * (RIGHTU/64.0f);
      float vtl = yFrac * tl * (RIGHTU/64.0f);
#ifdef HYPERBOLIC_MAPPING
      VA[0]->U = u+utl_+PMT->TX;
      VA[0]->V = v+vtl_+PMT->TY;
      VA[1]->U = u+utl +PMT->TX;
      VA[1]->V = v+vtl_+PMT->TY;
      VA[2]->U = u+utl +PMT->TX;
      VA[2]->V = v+vtl +PMT->TY;
      VA[3]->U = u+utl_+PMT->TX;
      VA[3]->V = v+vtl +PMT->TY;
#else
      VA[0]->U = u+utl_;
      VA[0]->V = v+vtl_;
      VA[1]->U = u+utl ;
      VA[1]->V = v+vtl_;
      VA[2]->U = u+utl ;
      VA[2]->V = v+vtl ;
      VA[3]->U = u+utl_;
      VA[3]->V = v+vtl ;
#endif
      // Transform Vertices and calculate clipping flags
      for(i=0;i<4;i++,V++)
      {
            Vtx = VA[i];
            Vtx->TPos.x = g_VP.CX * V->z + g_VP.K * V->x;
            Vtx->TPos.y = g_VP.CY * V->z - g_VP.K * V->y;
            Vtx->TPos.z = V->z;
            Vtx->RZ = 1.0f/Vtx->TPos.z;
            Vtx->PX = Vtx->TPos.x * Vtx->RZ;
            Vtx->PY = Vtx->TPos.y * Vtx->RZ;
            Vtx->UZ = Vtx->U*Vtx->RZ;
            Vtx->VZ = Vtx->V*Vtx->RZ;
            VertexFlags(Vtx);
      }
```

```
     // Set up texturing parameters
     Q->Tex = PMT->Texture->Tex;
     Q->drawlev = drawlevel;
     Q->availlev = PMT->Level;//Q->MT->Level;//Parent-
>Level;

     // Update data integrity
     g_TM.DataIntegrityNorm += pow2fast(-2*(MT->Level + Q-
>drawlev));
     g_TM.DataIntegrity += pow2fast(-2*(MT->Level + Q-
>drawlev-Q->availlev ));
     g_TM.DataIntegrityMax += pow2fast(-2*MT->Level);


     // Rasterize Q on Expansion map
     long qlvl = Q->MT->Level;
     long qscanline = (1 << (g_TM.MaxLevel-1)) + 2;
     long qlength = 1 << ((g_TM.MaxLevel-1) - qlvl);
     long qposx = qlength * Q->MT->TX + 1;
     long qposy = qlength * Q->MT->TY + 1;
     byte * qptr = g_TM.ExpansionMap + qposx + qposy *
qscanline;
     for(j=0;j<qlength;j++,qptr += qscanline)
          memset(qptr, qlvl, qlength);

}

// Renders all of the generated Quadritherals.
void SpliceVertex(Vertex *A,Vertex *B,float t,Vertex *V)
{
     float s=1.0f-t;
     V->TPos.x = A->TPos.x * s + B->TPos.x * t;
     V->TPos.y = A->TPos.y * s + B->TPos.y * t;
     V->TPos.z = A->TPos.z * s + B->TPos.z * t;

     V->U = A->U * s + B->U * t;
     V->V = A->V * s + B->V * t;

     V->RZ = 1.0f/V->TPos.z;
     V->PX = V->TPos.x * V->RZ;
     V->PY = V->TPos.y * V->RZ;

     V->UZ = V->U * V->RZ;
     V->VZ = V->V * V->RZ;
```

```
	// kickass
	if (A->Flags | B->Flags)
		VertexFlags(V);
	else
		V->Flags = 0;
}
void RenderQuads()
{
	Quad *Q,*QE;
	MapTile *MT;


	if (!NumQuads) return;

	long i,j;

	dufactor= Quads->availlev;

	static Vertex SVBuffer[48];
	static Vertex *VA[3];

	Texture Tx;
	Tx._l2xRes = 6;
	Tx._l2yRes = 6;
	Tx._stateFlags = 0;
	Tx._PF = PF_R5G6B5;
#ifndef _FLY_OVER_WIN_CE
	// Set to Eyal's Texture mapper.
	RR_SetTextureMapper(TMapper_Interface);
	Tx._stateFlags |= TSF_BLOCKTILED;
#else
	// Set to Refraster with std. inner
	RR_SetTextureMapper(TMapper_Standard);
	RR_SetTextureInner(TInner_Standard);
#endif

	for(Q=Quads,QE=Q+NumQuads;Q<QE;Q++)
	{
		Vertex *SVBWrite = SVBuffer;
		int was_visible = 0;
		Tx._data = Q->Tex;
		RR_SetTexture(&Tx);
		FillColor_ = (byte)Q->drawlev;

		C_Flags = Vtx_Visibility&(Q->A.Flags|Q-
>B.Flags|Q->C.Flags|Q->D.Flags);
		g_lvldiff = Q->availlev;
```

```
            Vertex **Vtx = C_Buf;

            //if ( GetAsyncKeyState('B') )
            //{
/*          *Vtx++ = &Q->D;

            /// Add (Insert) Vertices to fix CRACKS

            long qlvl = Q->MT->Level;
            long qmaxlev = g_TM.MaxLevel - 1;
            long qscanline = (1 << qmaxlev) + 2;
            long qlength = 1 << (qmaxlev - qlvl);
            long qposx = qlength * Q->MT->TX + 1;
            long qposy = qlength * Q->MT->TY + 1;

            byte * qscantop = g_TM.ExpansionMap + qposy *
qscanline + qposx;
            byte * qscanbottom = qscantop + qlength *
qscanline;
            const long maxlev = g_TM.MaxLevel - 1;
            float t;

            // SCAN D->C
            byte * qscan = qscanbottom,
                  * qscanend = qscanbottom+qlength;

            byte read;
            // Initial READ from expansion map
            read = *qscan;
            qscan += 1 << (maxlev - read);
            t = powerbase2[qlvl - read];

            while (qscan<qscanend)
            {
                  // Subsequent READS / VERTEX SPLICING
                  SpliceVertex(&Q->D,&Q->C,t,SVBWrite);
                  *Vtx++ = SVBWrite++;
                  read = *qscan;
                  qscan += 1 << (maxlev - read);
                  t += powerbase2[qlvl - read];
            }

            *Vtx++ = &Q->C;

            // SCAN C->B
            qscan = qscanbottom+qlength-qscanline;
```

```
qscanend = qscantop+qlength;
read = *qscan;
qscan -= qscanline << (maxlev - read);
t = powerbase2[qlvl - read];
while (qscan>=qscanend)
{
     // Subsequent READS / VERTEX SPLICING
     SpliceVertex(&Q->C,&Q->B,t,SVBWrite);
     *Vtx++ = SVBWrite++;
     read = *qscan;
     qscan -= qscanline << (maxlev - read);
     t += powerbase2[qlvl - read];
}

*Vtx++ = &Q->B;

// SCAN B->A
qscan = qscantop-qscanline+qlength-1;
qscanend = qscantop-qscanline;
read = *qscan;
qscan -= 1 << (maxlev - read);
t = powerbase2[qlvl - read];
while (qscan>=qscanend)
{
     SpliceVertex(&Q->B,&Q->A,t,SVBWrite);
     *Vtx++ = SVBWrite++;
     read = *qscan;
     qscan -= 1 << (maxlev - read);
     t += powerbase2[qlvl - read];
}

*Vtx++ = &Q->A;

// SCAN A->D
qscan = qscantop-1;
qscanend = qscanbottom-1;
read = *qscan;
qscan += qscanline << (maxlev - read);
t = powerbase2[qlvl - read];
while (qscan<qscanend)
{
     SpliceVertex(&Q->A,&Q->D,t,SVBWrite);
     *Vtx++ = SVBWrite++;
     read = *qscan;
     qscan += qscanline << (maxlev - read);
     t += powerbase2[qlvl - read];
}*/
```

```
            //} else {
                 *Vtx++ = &Q->D;
                 *Vtx++ = &Q->C;
                 *Vtx++ = &Q->B;
                 *Vtx++ = &Q->A;
            //}

            C_NumVtx = Vtx - C_Buf;

            if (C_Flags)
            {
                 FrustrumClipper(Referance_Rasterizer);
            }
            else
            {
                 C_Prim = C_Buf;
                 MT = Q->MT;
                 while (MT->Level>Q->availlev) MT=MT->Parent;
                 if (0)//(MT->Flags & MT_JIT)
                 {
                      //MT->Flags &= ~MT_JIT;
                      i = C_NumVtx;
                      C_NumVtx = 3;
                      VA[0] = C_Prim[0];
                      VA[2] = C_Prim[1];
                      for(j=2;j<i;j++)
                      {
                           VA[1] = VA[2];
                           VA[2] = C_Prim[j];
                           //Texture_Mapper(&F,C_Buf);
                           Rasterizer(VA);
                      }
                 } else {
                      Referance_Rasterizer(C_Prim);
                 }
            }

            if (C_NumVtx) was_visible=1;

            /*C_Buf[0] = F.A = &Q->D;
            C_Buf[1] = F.B = &Q->B;
            C_Buf[2] = F.C = &Q->A;

            C_Flags = Vtx_Visibility&(Q->A.Flags|Q-
>B.Flags|Q->D.Flags);
            C_NumVtx = 3;
```

```
          if (C_Flags)
               FrustrumClipper(&F);
          else
//             Rasterizer(&F,C_Buf);
               Texture_Mapper(&F,C_Buf);

          if (C_NumVtx) was_visible=1;*/

          if (was_visible)
          {
               // Reinsert to Cache
               MT = Q->MT;
               while (MT->Level>Q->availlev) MT=MT->Parent;
               for(;MT;MT=MT->Parent)
                    if (MT->Texture)
                         UpdateTNode(MT->Texture);
                    else
                         int bummer = 1;


               // Debugging code for distorted polygon
surface
               /*float surface = PolygonSurface();
               static float bound = 1.0;
               if (GetAsyncKeyState('V')) bound*=1.02;
               if (GetAsyncKeyState('C')) bound/=1.02;
               if (surface > bound) {
                    VA[0] = C_Prim[0];
                    VA[2] = C_Prim[1];

                    for(i=2;i<C_NumVtx;++i)
                    {
                         VA[1] = VA[2];
                         VA[2] = C_Prim[i];
                         Rasterizer(&F,VA);
                    }
               }else {
                    int yadda = 1;
               }*/
               // for visible polygons, look for the
lowest-level parent
               // missing a texture, and add a download
request for that parent.
               if (g_TM.UpdateDL)
               {
                    MT = Q->MT;
                    if (MT->Texture) continue;
```

```
                        while(!MT->Parent->Texture) MT=MT-
>Parent;
                        DLAdd(Q,MT);
                    }
                }
            }


// renders the contents (tiles) inside TM's quadtree
void TileManagerRender()
{
    if (g_TM.UpdateDL) DLReset();
    QuadReset();
    TileRecalcPlane();

    // generate square
    Vector3 A,B,C,D;
    VectorCopy(&A,&g_TM.Origin);
    VectorLComb(&A,&g_TM.XAxis,1.0f,(float)g_TM.TSize[0],&B
);
    VectorLComb(&A,&g_TM.YAxis,1.0f,(float)g_TM.TSize[0],&D
);
    VectorLComb(&B,&g_TM.YAxis,1.0f,(float)g_TM.TSize[0],&C
);

    Vector3 *VP[4] = {&A,&B,&C,&D};
    Fast_WithinFrustrum_Init(&g_VP,VP);
    CalculateDDX(VP);

    // niark - clear expansion map
    dword EMLen = (1 << (g_TM.MaxLevel-1)) +2;
    memset(g_TM.ExpansionMap,0,sizeof(byte)*  EMLen*EMLen
);

    g_TM.DataIntegrity = g_TM.DataIntegrityNorm =
g_TM.DataIntegrityMax = 0.0f;
    DrawTileMap(g_TM.MT,VP[0],VP[1],VP[2],VP[3]);
    g_TM.DataIntegrity = 1.0f - log(g_TM.DataIntegrity /
g_TM.DataIntegrityMax) /
(float)log(g_TM.DataIntegrityNorm/g_TM.DataIntegrityMax);
    RenderQuads();

    _/* need only for the debugging- create the little blue
square
    // understand it.
    // render expansion map
```

```
    _/*long i,j;
    word *ptr = g_pVPage+100;
    byte *src = g_TM.ExpansionMap;
    for(j=0;j<EMLen;j++)
    {
        for(i=0;i<EMLen;i++)
        {
            *ptr++ = Palette[*src++];
        }
        ptr += g_xRes-EMLen;
    }*/

    //TileMapRemoveJIT();
    TTexStorage2Cache();


    static long LastUpdateTime;
    if (g_TM.UpdateDL)
    {
        LastUpdateTime = g_timer;
        DLManager();
    }
    // 1 second delay
    g_TM.UpdateDL = (g_timer - LastUpdateTime > TMR_RESO);
}
```

Module: DL.cpp

```
dword DLGetNext(DownloadRequest *pRet)
{
     //Lock DTL MUTEX
     WaitForSingleObject(g_hDataMutex, INFINITE);

     DownloadRequest *Retval = 0;

     for(;;)
     {
          if (DTLNextAvail<DTLMax)
          {
               // check this map tile isn't already being
downloaded,
               Retval = DTL+DTLNextAvail++;
               if (Retval->MT->Flags & MT_Downloading)
               {
                    Retval = 0;
                    continue;
               }
               Retval->MT->Flags |= MT_Downloading;
          }

          break;
     }

     if (Retval)
          memcpy(pRet, Retval, sizeof(DownloadRequest));

     //Unlock DTL MUTEX
     ReleaseMutex(g_hDataMutex);

     return (dword)Retval;
}
void DLManager()
{
     static DownloadRequest **DPL = NULL;
     static DownloadRequest **DPS = NULL;

     static dword I;

     dword N = g_TM.DLNumRequests;

     if (N>DTLSize)
     {
```

```
          // re-allocate DPL/DPS  and downloader thread's
list
          DPL = (DownloadRequest
**)realloc(DPL,sizeof(DownloadRequest *) *N);
          DPS = (DownloadRequest
**)realloc(DPS,sizeof(DownloadRequest *) *N);

          // note. information inside DTL still valid
because
          // the [partial] list contents were transferred
during
          // the reallocation

          // get DTL MUTEX
          WaitForSingleObject(g_hDataMutex, INFINITE);

          // realloc DTL
          DTL = (DownloadRequest
*)realloc(DTL,sizeof(DownloadRequest)*N);
          DTLSize = N;

          // release DTL MUTEX
          //ReleaseMutex(g_hDataMutex);
     }
     // rebuild DPL
     for(I=0;I<N;I++)
     {
          DPL[I] = g_TM.DLRequests+I;
     }

     // sort into DPL (DPS may be usable as temporary
storage)
     PrioritySort(DPL,DPS,N);

     /*Quad *Q,*QE;
     if (GetAsyncKeyState('U'))
     {
          for(Q=Quads,QE=Q+NumQuads;Q<QE;Q++)
          {
               if (Q->MT == DPL[0]->MT)
               {
                    long x = Q->A.PX;
                    long y = Q->A.PY;
                    if (x>0&&x<g_xRes-1&&y>0&&y<g_yRes-1)
                    {
                         word *w = g_pVPage+y*g_xRes+x;
```

```
                              w[-(sdword)g_xRes] = w[-1] = w[0]
= w[1] = w[g_xRes] = 0xFFFF;
                         }
                    }
               }
          }*/


          // get DTL MUTEX
          //WaitForSingleObject(g_hDataMutex, INFINITE);

          // transfer DPS[I] to a new block inside DTL
          for(I=0;I<N;I++)
               memcpy(DTL+I,DPL[I],sizeof(DownloadRequest));
          //memcpy(DTL,g_TM.DLRequests,sizeof(DownloadRequest)*N
);
          DTLMax = N;
          // reset DTL Next Available number to 0
          DTLNextAvail = 0;

          // release DTL MUTEX
          ReleaseMutex(g_hDataMutex);
}

void DLDownloaderThread(void *var)
{
          DownloadRequest     dl;

          // increase downloader thread count
//        nThreads = GetNThreads();
//        SetNThreads(nThreads+1);

          l_nDownloaderThreads++;


          for (;;)
          {
               while (DLGetNext(&dl) == 0)
               {
                    // need we terminate ?
                    if (l_stopDownloadThreads)
                         // yes, break loop
                         break;

                    // sleep some time, then check again
                    Sleep(100);
               }
```

```
          // do we need to terminate this thread and others
?
          if (l_stopDownloadThreads)
          {
               // decrease number of running threads
               l_nDownloaderThreads--;

               return;
          }

          byte *buf;
          dword     len;

          Http11Request( g_TM.pServerName,
                              g_TM.pMapDir,
                              dl.FOffset,

     dl.FOffset+g_TM.IMAGE_CELL_SIZE-1,
                              g_TM.serverPort,
                              (void**)&buf, &len);

          //Sleep(500); // forcefully delays downloading,
used for debugging
          if (len)
               DLRecieve(dl.MT,buf);
          else
               dl.MT->Flags &=~MT_Downloading;

          delete buf;
     }
}
```

Module: DCam.cpp

```
void Dynamic_Camera(DCam *DC)
{
#ifndef _FLY_OVER_WIN_CE
     Camera *Cm = DC->Cm;
     Vector3 V;
     Matrix R,M;

     float dt = g_fgdtime;

     if (GetAsyncKeyState('I')) DC->KS*=expf(dt*2.0f);
     if (GetAsyncKeyState('O')) DC->KS*=expf(-dt*2.0f);

     // Kinematics
     VectorScale(&DC->Vel,dt,&V);
     VectorSelfAdd(&Cm->Position,&V);
     VectorScale(&DC->RVel,dt,&V);
     VectorSelfAdd(&DC->Rotation,&V);
     // rotation clipping
     //if (DC->Rotation.x > HALFPI*0.999) DC->Rotation.x =
HALFPI*0.999;
     //if (DC->Rotation.x <-HALFPI*0.999) DC->Rotation.x =-
HALFPI*0.999;
     if (DC->Rotation.y <-PI) DC->Rotation.y += TWOPI;
     if (DC->Rotation.y > PI) DC->Rotation.y -= TWOPI;

     // Orientation
     //VectorScale(&DC->RVel,dt,&V);
     //Euler_Angles(R,V.x,V.y,V.z);
     //MatrixXMatrix(R,DC->VM,M);
     Matrix BT,ET;
     Euler_Angles(BT,0,DC->Rotation.y,0);
     Euler_Angles(ET,DC->Rotation.x,0,0);
     MatrixXMatrix(ET,BT,DC->VM);
//   MatrixCopy(DC->VM,M);
//   Euler_Angles(R,0,0,DC->Roll);
//   MatrixXMatrix(R,DC->VM,Cm->VM);

     // Adjust by Keyboard Input
     float dtks = dt * DC->KS;
     if (GetAsyncKeyState(VK_NEXT))
     {
          DC->Vel.x += dtks * Cm->VM[0];
          DC->Vel.y += dtks * Cm->VM[1];
          DC->Vel.z += dtks * Cm->VM[2];
```

```
	}
	if (GetAsyncKeyState(VK_END))
	{
		DC->Vel.x -= dtks * Cm->VM[0];
		DC->Vel.y -= dtks * Cm->VM[1];
		DC->Vel.z -= dtks * Cm->VM[2];
	}
	if (GetAsyncKeyState(VK_SUBTRACT))
	{
		//DC->Vel.x += dtks * Cm->VM[3];
		DC->Vel.y += dtks;// * Cm->VM[4];
		//DC->Vel.z += dtks * Cm->VM[5];
	}
	if (GetAsyncKeyState(VK_ADD))
	{
		//DC->Vel.x -= dtks * Cm->VM[3];
		DC->Vel.y -= dtks;// * Cm->VM[4];
		//DC->Vel.z -= dtks * Cm->VM[5];
	}
	/*f (GetAsyncKeyState('A'))
	{
		DC->Vel.x += dtks * DC->VM[6];
		DC->Vel.y += dtks * Cm->VM[7];
		DC->Vel.z += dtks * DC->VM[8];
	}
	if (GetAsyncKeyState('Z'))
	{
		DC->Vel.x -= dtks * DC->VM[6];
		DC->Vel.y -= dtks * Cm->VM[7];
		DC->Vel.z -= dtks * DC->VM[8];
	}*/
	Vector3 Z_Motion = {DC->VM[6],0,DC->VM[8]}; // Z
motion
	float zl = VectorLength(&Z_Motion);
	if (zl<0.7)
	{
		VectorMake(&Z_Motion,BT[6],0,BT[8]);
	} else {
		VectorNorm(&Z_Motion);
	}

	if (GetAsyncKeyState('A'))
	{
		DC->Vel.x += dtks * Z_Motion.x;
		DC->Vel.z += dtks * Z_Motion.z;
	}
	if (GetAsyncKeyState('Z'))
```

```
{
     DC->Vel.x -= dtks * Z_Motion.x;
     DC->Vel.z -= dtks * Z_Motion.z;
}
if (GetAsyncKeyState('S'))
{
     DC->Vel.x += dtks * DC->VM[6];
     DC->Vel.y += dtks * DC->VM[7];
     DC->Vel.z += dtks * DC->VM[8];
}
if (GetAsyncKeyState('X'))
{
     DC->Vel.x -= dtks * DC->VM[6];
     DC->Vel.y -= dtks * DC->VM[7];
     DC->Vel.z -= dtks * DC->VM[8];
}


// TODO - check if our window is active

float dtrks = dt * DC->RKS;
if (GetAsyncKeyState(VK_UP)) DC->RVel.x += dtrks;
if (GetAsyncKeyState(VK_DOWN)) DC->RVel.x -= dtrks;

if (GetAsyncKeyState(VK_RIGHT))
{
     //DC->Roll += dt * DC->TRoll;
     DC->RVel.y += dtrks;
}
if (GetAsyncKeyState(VK_LEFT))
{
     //DC->Roll -= dt * DC->TRoll;
     DC->RVel.y -= dtrks;
}
if (GetAsyncKeyState(VK_HOME)) DC->RVel.z += dtrks;
if (GetAsyncKeyState(VK_PRIOR)) DC->RVel.z -= dtrks;

// Movement dampening
float falloff;
falloff = (float)exp(-dt*DC->Damp);
VectorSelfScale(&DC->Vel,falloff);
// Rotation dampening
falloff = (float)exp(-dt*DC->RDamp);
VectorSelfScale(&DC->RVel,falloff);

// Roll dampening
//falloff = (float)exp(-dt*DC->RlDamp);
```

```
      //DC->Roll *= falloff;
      DC->Roll += DC->RVel.z * 0.05;

      // Verify height
      if (Cm->Position.y < DC->minY)
           Cm->Position.y = DC->minY;

      // Auto-Levelling
      Vector3 *VMP = (Vector3 *)DC->VM;
      VMP[0].y = 0.0;
      VectorNorm(VMP);
      VectorCross(VMP+2,VMP,VMP+1);
      VectorNorm(VMP+1);
      VectorCross(VMP,VMP+1,VMP+2);

      //MatrixIdentity(Cm->VM);
      Euler_Angles(R,0,0,DC->Roll);
      MatrixXMatrix(R,DC->VM,Cm->VM);

#else
      Camera *Cm = DC->Cm;
      Vector3 V;
      Matrix R,M;

      float dt = g_fgdtime;

      if (GetAsyncKeyState('I')) DC->KS*=expf(dt*2.0f);
      if (GetAsyncKeyState('O')) DC->KS*=expf(-dt*2.0f);

      // Kinematics
      VectorScale(&DC->Vel,dt,&V);
      VectorSelfAdd(&Cm->Position,&V);
      VectorScale(&DC->RVel,dt,&V);
      VectorSelfAdd(&DC->Rotation,&V);
      // rotation clipping
      //if (DC->Rotation.x > HALFPI*0.999) DC->Rotation.x =
HALFPI*0.999;
      //if (DC->Rotation.x <-HALFPI*0.999) DC->Rotation.x =-
HALFPI*0.999;
      if (DC->Rotation.y <-PI) DC->Rotation.y += TWOPI;
      if (DC->Rotation.y > PI) DC->Rotation.y -= TWOPI;

      // Orientation
      //VectorScale(&DC->RVel,dt,&V);
      //Euler_Angles(R,V.x,V.y,V.z);
      //MatrixXMatrix(R,DC->VM,M);
      Matrix BT,ET;
```

```
      Euler_Angles(BT,0,DC->Rotation.y,0);
      Euler_Angles(ET,DC->Rotation.x,0,0);
      MatrixXMatrix(ET,BT,DC->VM);
//    MatrixCopy(DC->VM,M);
//    Euler_Angles(R,0,0,DC->Roll);
//    MatrixXMatrix(R,DC->VM,Cm->VM);

      // Adjust by Keyboard Input
      float dtks = dt * DC->KS;
/*    if (GetAsyncKeyState(VK_NEXT))
      {
           DC->Vel.x += dtks * Cm->VM[0];
           DC->Vel.y += dtks * Cm->VM[1];
           DC->Vel.z += dtks * Cm->VM[2];
      }
      if (GetAsyncKeyState(VK_END))
      {
           DC->Vel.x -= dtks * Cm->VM[0];
           DC->Vel.y -= dtks * Cm->VM[1];
           DC->Vel.z -= dtks * Cm->VM[2];
      }
      if (GetAsyncKeyState(VK_SUBTRACT))
      {
           //DC->Vel.x += dtks * Cm->VM[3];
           DC->Vel.y += dtks;// * Cm->VM[4];
           //DC->Vel.z += dtks * Cm->VM[5];
      }
      if (GetAsyncKeyState(VK_ADD))
      {
           //DC->Vel.x -= dtks * Cm->VM[3];
           DC->Vel.y -= dtks;// * Cm->VM[4];
           //DC->Vel.z -= dtks * Cm->VM[5];
      }
      f (GetAsyncKeyState('A'))
      {
           DC->Vel.x += dtks * DC->VM[6];
           DC->Vel.y += dtks * Cm->VM[7];
           DC->Vel.z += dtks * DC->VM[8];
      }
      if (GetAsyncKeyState('Z'))
      {
           DC->Vel.x -= dtks * DC->VM[6];
           DC->Vel.y -= dtks * Cm->VM[7];
           DC->Vel.z -= dtks * DC->VM[8];
      }*/
      Vector3 Z_Motion = {DC->VM[6],0,DC->VM[8]}; // Z
motion
```

```
	float zl = VectorLength(&Z_Motion);
	if (zl<0.000001)
	{
		VectorMake(&Z_Motion,-DC->VM[3],-DC->VM[4],-DC-
>VM[5]);
	} else {
		VectorNorm(&Z_Motion);
	}

	static int state = 0;
	static int pressed = 0;

	if ( GetAsyncKeyState(VK_F23) && (!pressed) )
	{
		pressed = 1;
		state = !state;
	}
	else
	{
		pressed = 0;
	}

	float dtrks = dt * DC->RKS;

	if (state)
	{
		if (GetAsyncKeyState(VK_UP))
		{
			DC->Vel.x += dtks * DC->VM[6];
			DC->Vel.y += dtks * DC->VM[7];
			DC->Vel.z += dtks * DC->VM[8];
		}
		if (GetAsyncKeyState(VK_DOWN))
		{
			DC->Vel.x -= dtks * DC->VM[6];
			DC->Vel.y -= dtks * DC->VM[7];
			DC->Vel.z -= dtks * DC->VM[8];
		}
		if (GetAsyncKeyState(VK_RIGHT))
		{
			DC->RVel.x += dtrks;
		}
		if (GetAsyncKeyState(VK_LEFT))
		{
			DC->RVel.x -= dtrks;
		}
	}
```

```
    else
    {
        if (GetAsyncKeyState(VK_UP))
        {
            DC->Vel.x += dtks * Z_Motion.x;
            DC->Vel.z += dtks * Z_Motion.z;
        }
        if (GetAsyncKeyState(VK_DOWN))
        {
            DC->Vel.x -= dtks * Z_Motion.x;
            DC->Vel.z -= dtks * Z_Motion.z;
        }
        if (GetAsyncKeyState(VK_RIGHT))
        {
            //DC->Roll += dt * DC->TRoll;
            DC->RVel.y += dtrks;
        }
        if (GetAsyncKeyState(VK_LEFT))
        {
            //DC->Roll -= dt * DC->TRoll;
            DC->RVel.y -= dtrks;
        }
    }
/*  if (GetAsyncKeyState('S'))
    {
        DC->Vel.x += dtks * DC->VM[6];
        DC->Vel.y += dtks * DC->VM[7];
        DC->Vel.z += dtks * DC->VM[8];
    }
    if (GetAsyncKeyState('X'))
    {
        DC->Vel.x -= dtks * DC->VM[6];
        DC->Vel.y -= dtks * DC->VM[7];
        DC->Vel.z -= dtks * DC->VM[8];
    }*/


    // TODO - check if our window is active

//  if (GetAsyncKeyState(VK_UP)) DC->RVel.x += dtrks;
//  if (GetAsyncKeyState(VK_DOWN)) DC->RVel.x -= dtrks;

//  if (GetAsyncKeyState(VK_HOME)) DC->RVel.z += dtrks;
//  if (GetAsyncKeyState(VK_PRIOR)) DC->RVel.z -= dtrks;

    // Movement dampening
    float falloff;
```

```
      falloff = (float)exp(-dt*DC->Damp);
      VectorSelfScale(&DC->Vel,falloff);
      // Rotation dampening
      falloff = (float)exp(-dt*DC->RDamp);
      VectorSelfScale(&DC->RVel,falloff);

      // Roll dampening
      //falloff = (float)exp(-dt*DC->RlDamp);
      //DC->Roll *= falloff;
      DC->Roll += DC->RVel.z * 0.05;

      // Verify height
      if (Cm->Position.y < DC->minY)
           Cm->Position.y = DC->minY;

      // Auto-Levelling
      Vector3 *VMP = (Vector3 *)DC->VM;
      VMP[0].y = 0.0;
      VectorNorm(VMP);
      VectorCross(VMP+2,VMP,VMP+1);
      VectorNorm(VMP+1);
      VectorCross(VMP,VMP+1,VMP+2);

      //MatrixIdentity(Cm->VM);
      Euler_Angles(R,0,0,DC->Roll);
      MatrixXMatrix(R,DC->VM,Cm->VM);
#endif
}


// funcs
dword Http11Request(char  *pServer,      // 'www.imr.org'
                    char  *pFile,  //
'/images/logo.jpg'
                    dword       rangeFrom,// 450, -1
(-1 == from begining of file)
                    dword       rangeTo,      // 500, -
1 (-1 == till end of file)
                    word   port,         // 80
                    void **ppDestFileBuf,
                    dword      *pDestFileLen)
{
      struct hostent      *pHost;
      struct sockaddr_in   serverAddr;
      SOCKET                    serverSock;
      int                       retVal;
      dword                     exitError = 0;
```

```
      char                  *recipientServerName;

      // nulify reply
      *ppDestFileBuf = 0;
      *pDestFileLen = 0;

      // are using a proxy server ?
      recipientServerName = l_useProxy ? l_pProxyServer :
pServer;

      // retreive server IP
      if (isalpha(recipientServerName[0]))
            pHost = gethostbyname(recipientServerName);
      else
      {
            dword addr;
            addr = inet_addr(recipientServerName);
            pHost = gethostbyaddr((char *)&addr, 4, AF_INET);
      }

      if (pHost == 0)
      {
            /*LogMsg("Http11Request(): unable to resolve
[%s], Error [%d]",
                  recipientServerName, WSAGetLastError());*/

            HTTP_ERROR(Http11Request_ErrLvl1)
      }

      // Copy the resolved information into the sockaddr_in
structure
      memset(&serverAddr, 0, sizeof(serverAddr));
      memcpy(&(serverAddr.sin_addr), pHost->h_addr, pHost-
>h_length);
      serverAddr.sin_family = pHost->h_addrtype;
      serverAddr.sin_port = htons(l_useProxy ? l_proxyPort :
port);

      // open a socket
      if ((serverSock = socket(AF_INET, SOCK_STREAM, 0)) ==
INVALID_SOCKET)
      {
            /*LogMsg("Http11Request(): failed to open socket
to server [%s], Error [%d]",
                  pServer, WSAGetLastError());*/

            HTTP_ERROR(Http11Request_ErrLvl1)
```

```
    }

    /// connect to the server
    if (connect(serverSock, (struct sockaddr*)&serverAddr,
sizeof(serverAddr))
        == SOCKET_ERROR)
    {
        //LogMsg("Http11Request(): failed to connect to
server [%s], Error [%d]",
        //davidi  pServer, WSAGetLastError());

        HTTP_ERROR(Http11Request_ErrLvl2)
    }

    // generate our request
    char *pRequestBuf;

    pRequestBuf = new char [REQUEST_BUFFER_SIZE];

    memset(pRequestBuf, 0, REQUEST_BUFFER_SIZE);

    //GET /index.html HTTP/1.1
    //Connection: Keep-Alive
    //Host: 10.1.1.1
    //Range: bytes=10-20

    //GET http://www.yahoo.com/blah/index.html HTTP/1.0
    //Host: www.yahoo.com
    //Proxy-Connection: Keep-Alive

    strcpy(pRequestBuf, "GET ");

    if (!l_useProxy)
    {
        strcat(pRequestBuf, pFile);
        strcat(pRequestBuf, " HTTP/1.1\r\n");
        strcat(pRequestBuf, "Connection: Keep-
Alive\r\n");
    }
    else
    {
        strcat(pRequestBuf, "http://");
        strcat(pRequestBuf, pServer);
        strcat(pRequestBuf, pFile);
        strcat(pRequestBuf, " HTTP/1.0\r\n");
        strcat(pRequestBuf, "Proxy-Connection: Keep-
Alive\r\n");
```

```
    }

    strcat(pRequestBuf, "Host: ");
    strcat(pRequestBuf, pServer);
    strcat(pRequestBuf, "\r\n");


    // do we have byte ranges ?
    if (rangeFrom != -1 || rangeTo != -1)
    {
         // we need to take care of ranges
         strcat(pRequestBuf, "Range: bytes=");

         // from range
         char rangeString[32];

         sprintf(rangeString, "%d-", rangeFrom == -1 ? 0 :
rangeFrom);
         strcat(pRequestBuf, rangeString);

         // to range
         if (rangeTo != -1)
         {
              sprintf(rangeString,"%d", rangeTo);
              strcat(pRequestBuf, rangeString);
         }

         strcat(pRequestBuf, "\r\n");
    }

    strcat(pRequestBuf, "\r\n");

    // send request
    if (send(serverSock, pRequestBuf, strlen(pRequestBuf),
0) == SOCKET_ERROR)
    {
         /*LogMsg("Http11Request(): send() failed, Error
[%d]",
              pServer, WSAGetLastError());*/

         delete pRequestBuf;

         HTTP_ERROR(Http11Request_ErrLvl2)
    }
    delete pRequestBuf;
```

```
     // receive response

     /////////////////
     // NOTE! response buffer now gets padded with
additional 2Kbytes due to out of array bound
     // writes made by the following code. This is a bug
detected by Yoni on 27/7/01,
     // however it isn't fixed because of my inexperiance
with networking code.
     char *pResponseBuf;

     //pResponseBuf = new char[RESPONSE_BUFFER_SIZE];
     char *paddedBuffer;
     paddedBuffer = new char [RESPONSE_BUFFER_SIZE+2048];
     pResponseBuf = &paddedBuffer[1024];

     if ((retVal = recv(serverSock, (char*)pResponseBuf,
RESPONSE_BUFFER_SIZE, 0)) <= 0)
     {
          /*LogMsg("Http11Request(): recv() failed,%sError
[%d]",
               (retVal == 0) ? " connection gracefully
closed, " : " ",
               WSAGetLastError());*/

          HTTP_ERROR(Http11Request_ErrLvl3)
     }

     pResponseBuf[retVal] = 0;

     // fetch http return-code
     // 'HTTP/1.1 206 Partial Content'

     dword     httpVer[2], httpResponseCode;

     sscanf((const char*)pResponseBuf, "HTTP/%d.%d %d",
&httpVer[0], &httpVer[1], &httpResponseCode);

     switch (httpResponseCode)
     {
     case 200: // ok
     case 206: // partial content
          break;

     case 302: // moved temporarily
          break;
```

```
     case 204: // no content
          //LogMsg("Http11Request(): HTTP error 204 (no
content)");
          HTTP_ERROR(Http11Request_ErrLvl3)

     case 400: // bad request
          //LogMsg("Http11Request(): HTTP error 400 (bad
request)");
          HTTP_ERROR(Http11Request_ErrLvl3)

     case 401: // unauthorized
          //LogMsg("Http11Request(): HTTP error 401
(unauthorized)");
          HTTP_ERROR(Http11Request_ErrLvl3)

     case 404: // not found
          //LogMsg("Http11Request(): HTTP error 404 (not
found)");
          HTTP_ERROR(Http11Request_ErrLvl3)

     case 405: // method not allowed
          //LogMsg("Http11Request(): HTTP error 405 (method
not allowed)");
          HTTP_ERROR(Http11Request_ErrLvl3)

     case 406: // not acceptable
          //LogMsg("Http11Request(): HTTP error 406 (not
acceptable)");
          HTTP_ERROR(Http11Request_ErrLvl3)

     case 500: // server error
          //LogMsg("Http11Request(): HTTP error 503 (server
error)");
          HTTP_ERROR(Http11Request_ErrLvl3)

     case 503: // out of resources
          //LogMsg("Http11Request(): HTTP error 503 (out of
resources)");
          HTTP_ERROR(Http11Request_ErrLvl3)

     case 505: // http version not supported
          //LogMsg("Http11Request(): HTTP error 505 (http
version not supported)");
          HTTP_ERROR(Http11Request_ErrLvl3)

     default:
```

```
          //LogMsg("Http11Request(): HTTP error %d",
httpResponseCode);
          HTTP_ERROR(Http11Request_ErrLvl3)
     }

     // if we reached here, it means the file is comming

     dword      receivedFileLen, receivedFileOfs;
     byte *pReceivedFile;
     dword      expectedFileSize;

     receivedFileLen = 0;
     receivedFileOfs = 0;
     expectedFileSize = 0;
     pReceivedFile = 0;

     // do we know the file size ?

     if (rangeTo != -1)
     {
          // if we have a 'to' range, it means we can
determine the requested
          // data length

          if (rangeFrom == -1)
               expectedFileSize = rangeTo;
          else
               expectedFileSize = rangeTo - rangeFrom + 1;
     }
     else
          // look for content-length
     {
          char *pClPos;

          pClPos = strstr(pResponseBuf, "Content-Length:
");

          if (pClPos)
               sscanf(pClPos, "Content-Length: %d",
&expectedFileSize);
     }

     // did we manage to devise a content-length ?
     receivedFileLen = expectedFileSize ? expectedFileSize
: RESPONSE_BUFFER_SIZE;

     pReceivedFile = (byte*)malloc(receivedFileLen);
```

```
     // find double crlf in the 1'st packet, this tells us
where the header
     // ends and where the data begins

     char *dblCRLF;

     while ((dblCRLF = strstr(pResponseBuf, "\r\n\r\n")) ==
0)
          // odd, this packet doesn't contain our signal
     {
          // clear buffer
          memset(pResponseBuf, 0, RESPONSE_BUFFER_SIZE);

          // grab packet
          if ((retVal = recv(serverSock,
(char*)pResponseBuf, RESPONSE_BUFFER_SIZE, 0)) <= 0)
          {
               /*LogMsg("Http11Request(): recv()
failed,%sError [%d]",
                    (retVal == 0) ? " connection gracefully
closed, " : " ",
                    WSAGetLastError());*/

               HTTP_ERROR(Http11Request_ErrLvl4)
          }
     }


     // is there any binary data for us in this packet ?
     dword crlfPos;

     crlfPos = (dword)(dblCRLF - pResponseBuf);

     if (crlfPos+4 < (dword)retVal)
     {
          // there's binary data in the 1'st packet
          // since our target buffer is the size of the
incoming buffer
          // and the incoming buffer includes a header, we
can safely copy
          // without fear of overlapping

          dword dataSize;

          dataSize = retVal - crlfPos - 4;
```

```
          memcpy(pReceivedFile, pResponseBuf+crlfPos+4,
dataSize);

          receivedFileOfs = dataSize;
     }

     // did the entire file fit into the first packet ?
     if (!expectedFileSize || (receivedFileOfs <
expectedFileSize))
     {
          // no, get more packets

          // now we go into a loop of receiveing and adding
to our file
          while ((retVal = recv(serverSock,
(char*)pResponseBuf, RESPONSE_BUFFER_SIZE, 0)) != 0)
          {
               // did the latest 'recv' call end with a
socket error ?
               if (retVal == -1)
               {
                    //davidi LogMsg("Http11Request():
recv() failed, Error [%d]", WSAGetLastError());

                    HTTP_ERROR(Http11Request_ErrLvl4)
               }

               // add packet to downloaded file
               if (receivedFileOfs + retVal >=
receivedFileLen)
               {
                    pReceivedFile =
(byte*)realloc(pReceivedFile,
receivedFileLen+RESPONSE_BUFFER_SIZE);

                    receivedFileLen +=
RESPONSE_BUFFER_SIZE;
               }

               memcpy(pReceivedFile+receivedFileOfs,
pResponseBuf, retVal);

               receivedFileOfs += retVal;

               // did we get the entire file ?
               // no need to test for validity of
'expectedFileSize' since 'receivedFileOfs'
```

```
                // can't be 0
                if (receivedFileOfs == expectedFileSize)
                    // yes, get out of the 'while' loop
                    break;
            }
        }

        // is it possible connection was closed gracefully,
and we didn't receive the entire file ?
        // if we have an expected size we can check this, but
i don't think it can happen
        if (expectedFileSize && (receivedFileOfs <
expectedFileSize))
        {
            //LogMsg("Http11Request(): recv() failed,
connection closed gracefully, but file not completely
received, Error [%d]", WSAGetLastError());

            HTTP_ERROR(Http11Request_ErrLvl4)
        }

        // here we are, connection was closed meaning we have
the file
        *ppDestFileBuf = new byte[receivedFileOfs];
        memcpy(*ppDestFileBuf, pReceivedFile,
receivedFileOfs);
        *pDestFileLen = receivedFileOfs;

Http11Request_ErrLvl4:
        free(pReceivedFile);

Http11Request_ErrLvl3:
        //delete [] pResponseBuf;
        delete [] paddedBuffer;

Http11Request_ErrLvl2:
        closesocket(serverSock);

Http11Request_ErrLvl1:
        return exitError ? IMR_ERR : IMR_COOL;
}

static void FClipper_Near()
{
        dword I,J = 0;
        IB_ = C_Prim[0];
```

```
	C_NFree = C_Isect;
	for(I=0;I<C_NumVtx;I++)
	{
		IA_ = IB_;
		IB_ = C_Prim[I+1];
		if  (IA_->Flags & Vtx_Near)
		{
			if (IB_->Flags & Vtx_Near) continue;
		} else {
			C_Scnd[J++] = IA_;
			if (!(IB_->Flags & Vtx_Near)) continue;
		}
		IVal_ = (g_VP.ZN-IA_->TPos.z)/(IB_->TPos.z-IA_-
>TPos.z);
		INVal_ = 1.0f-IVal_;
		C_NFree->TPos.x = INVal_ * IA_->TPos.x + IVal_ *
IB_->TPos.x;
		C_NFree->TPos.y = INVal_ * IA_->TPos.y + IVal_ *
IB_->TPos.y;
		C_NFree->TPos.z = g_VP.ZN;
//		C_NFree->R = INVal_ * IA_->R + IVal_ * IB_->R;
//		C_NFree->G = INVal_ * IA_->G + IVal_ * IB_->G;
//		C_NFree->B = INVal_ * IA_->B + IVal_ * IB_->B;
		C_NFree->U = INVal_ * IA_->U + IVal_ * IB_->U;
		C_NFree->V = INVal_ * IA_->V + IVal_ * IB_->V;

		C_NFree->PX = C_NFree->TPos.x * C_rZN;
		C_NFree->PY = C_NFree->TPos.y * C_rZN;
		C_NFree->RZ = C_rZN;
		C_NFree->UZ = C_NFree->U * C_rZN;
		C_NFree->VZ = C_NFree->V * C_rZN;

		Calc_Flags(C_NFree);
		C_Scnd[J++] = C_NFree++;
	}

	C_NumVtx = J;
	Clipper_Swap();
}

static void FClipper_Far()
{
	dword I,J = 0;
	IB_ = C_Prim[0];

	C_NFree = C_Isect+2;
	for(I=0;I<C_NumVtx;I++)
```

```
     {
          IA_ = IB_;
          IB_ = C_Prim[I+1];
          if  (IA_->Flags & Vtx_Far)
          {
               if (IB_->Flags & Vtx_Far) continue;
          } else {
               C_Scnd[J++] = IA_;
               if (!(IB_->Flags & Vtx_Far)) continue;
          }
          IVal_ = (g_VP.ZF-IA_->TPos.z)/(IB_->TPos.z-IA_-
>TPos.z);
          INVal_ = 1.0f-IVal_;
          C_NFree->PX = (INVal_ * IA_->TPos.x + IVal_ *
IB_->TPos.x) * C_rZF;
          C_NFree->PY = (INVal_ * IA_->TPos.y + IVal_ *
IB_->TPos.y) * C_rZF;
//        C_NFree->R = INVal_ * IA_->R + IVal_ * IB_->R;
//        C_NFree->G = INVal_ * IA_->G + IVal_ * IB_->G;
//        C_NFree->B = INVal_ * IA_->B + IVal_ * IB_->B;
          C_NFree->RZ = C_rZF;
          C_NFree->UZ = C_rZF * (INVal_ * IA_->U + IVal_ *
IB_->U);
          C_NFree->VZ = C_rZF * (INVal_ * IA_->V + IVal_ *
IB_->V);
          Calc_Flags(C_NFree);
          C_Scnd[J++] = C_NFree++;
     }

     C_NumVtx = J;
     Clipper_Swap();
}

// one day, with the appropriate technology, this will use
code-constructed procedures
static void FInterpolator()
{
     if (IVal_>1.0f || IVal_<0.0f)
     {
          int blat = 1;
     }
     C_NFree->PX = INVal_ * IA_->PX + IVal_ * IB_->PX;
     C_NFree->PY = INVal_ * IA_->PY + IVal_ * IB_->PY;
//   C_NFree->R = INVal_ * IA_->R + IVal_ * IB_->R;
//   C_NFree->G = INVal_ * IA_->G + IVal_ * IB_->G;
//   C_NFree->B = INVal_ * IA_->B + IVal_ * IB_->B;
     C_NFree->RZ = INVal_ * IA_->RZ + IVal_ * IB_->RZ;
```

```
        C_NFree->UZ = INVal_ * IA_->UZ + IVal_ * IB_->UZ;
        C_NFree->VZ = INVal_ * IA_->VZ + IVal_ * IB_->VZ;

        // calculate (U,V)
        float z = 1.0f/C_NFree->RZ;
        C_NFree->U = C_NFree->UZ*z;
        C_NFree->V = C_NFree->VZ*z;
}

static void FClipper_Left()
{
        dword I,J = 0;
        IB_ = C_Prim[0];

        C_NFree = C_Isect+4;
        for(I=0;I<C_NumVtx;I++)
        {
                IA_ = IB_;
                IB_ = C_Prim[I+1];
                if  (IA_->Flags & Vtx_Left)
                {
                        if (IB_->Flags & Vtx_Left) continue;
                } else {
                        C_Scnd[J++] = IA_;
                        if (!(IB_->Flags & Vtx_Left)) continue;
                }
                IVal_ = (g_VP.ClipX1-IA_->PX)/(IB_->PX-IA_->PX);
                INVal_ = 1.0f-IVal_;
                FInterpolator();
                C_NFree->PX = g_VP.ClipX1;
                Calc_YFlags(C_NFree);
                C_Scnd[J++] = C_NFree++;
        }

        C_NumVtx = J;
        Clipper_Swap();
}

static void FClipper_Right()
{
        dword I,J = 0;
        IB_ = C_Prim[0];

        C_NFree = C_Isect+6;
        for(I=0;I<C_NumVtx;I++)
        {
                IA_ = IB_;
```

```
            IB_ = C_Prim[I+1];
            if  (IA_->Flags & Vtx_Right)
            {
                 if (IB_->Flags & Vtx_Right) continue;
            } else {
                 C_Scnd[J++] = IA_;
                 if (!(IB_->Flags & Vtx_Right)) continue;
            }
            IVal_ = (g_VP.ClipX2-IA_->PX)/(IB_->PX-IA_->PX);
            INVal_ = 1.0f-IVal_;
            FInterpolator();
            C_NFree->PX = g_VP.ClipX2;
            Calc_YFlags(C_NFree);
            C_Scnd[J++] = C_NFree++;
       }

       C_NumVtx = J;
       Clipper_Swap();
}

static void FClipper_Up()
{
       dword I,J = 0;
       IB_ = C_Prim[0];

       C_NFree = C_Isect+8;
       for(I=0;I<C_NumVtx;I++)
       {
            IA_ = IB_;
            IB_ = C_Prim[I+1];
            if  (IA_->Flags & Vtx_Up)
            {
                 if (IB_->Flags & Vtx_Up) continue;
            } else {
                 C_Scnd[J++] = IA_;
                 if (!(IB_->Flags & Vtx_Up)) continue;
            }
            IVal_ = (g_VP.ClipY1-IA_->PY)/(IB_->PY-IA_->PY);
            INVal_ = 1.0f-IVal_;
            FInterpolator();
            C_NFree->PY = g_VP.ClipY1;
            C_Scnd[J++] = C_NFree++;
       }

       C_NumVtx = J;
       Clipper_Swap();
}
```

```
static void FClipper_Down()
{
     dword I,J = 0;
     IB_ = C_Prim[0];

     C_NFree = C_Isect+10;
     for(I=0;I<C_NumVtx;I++)
     {
          IA_ = IB_;
          IB_ = C_Prim[I+1];
          if  (IA_->Flags & Vtx_Down)
          {
               if (IB_->Flags & Vtx_Down) continue;
          } else {
               C_Scnd[J++] = IA_;
               if (!(IB_->Flags & Vtx_Down)) continue;
          }
          IVal_ = (g_VP.ClipY2-IA_->PY)/(IB_->PY-IA_->PY);
          INVal_ = 1.0f-IVal_;
          FInterpolator();
          C_NFree->PY = g_VP.ClipY2;
          C_Scnd[J++] = C_NFree++;
     }

     C_NumVtx = J;
     Clipper_Swap();
}

void FrustrumClipper(void (*RasterFunc)(Vertex **VA))
{
     dword I;

     C_Buf[C_NumVtx] = C_Buf[0];
     C_Prim = C_Buf;
     C_Scnd = C_Buf2;


     if (C_Flags&Vtx_Near)  FClipper_Near();
     if (C_Flags&Vtx_Far)   FClipper_Far();
     if (C_Flags&Vtx_Left)  FClipper_Left();
     if (C_Flags&Vtx_Right) FClipper_Right();
     if (C_Flags&Vtx_Up)    FClipper_Up();
     if (C_Flags&Vtx_Down)  FClipper_Down();


/*   if (!(CF->Txtr))
```

```
{1.04
        return;
    }
    //if
    while (C_NumVtx==3)
    {
        int mny = 0, ly = 2, ry = 1;
        if (C_Prim[mny]->PY > C_Prim[1]->PY)
        {
            mny = 1; ly = 0; ry = 2;
        }
        if (C_Prim[mny]->PY > C_Prim[2]->PY)
        {
            mny = 2; ly = 1; ry = 0;
        }

        if ((C_Prim[mny]->PY == C_Prim[ly]-
>PY)||(C_Prim[mny]->PY == C_Prim[ry]->PY)) return;

        if ( ((C_Prim[ry]->PX - C_Prim[mny]->PX) /
(C_Prim[ry]->PY - C_Prim[mny]->PY)) >
             ((C_Prim[ry]->PX - C_Prim[mny]->PX) /
(C_Prim[ry]->PY - C_Prim[mny]->PY)))
            test_texture(CF, C_Prim, C_NumVtx);
        C_NumVtx--;
    }
    C_NumVtx++;*/

    /*if (C_NumVtx>3)
    {

        C_Scnd[0] = C_Prim[0];
        C_Scnd[2] = C_Prim[1];
        dword J = C_NumVtx;
        C_NumVtx = 3;
        for(I=2;I<J;I++)
        {
            C_Scnd[1] = C_Scnd[2];
            C_Scnd[2] = C_Prim[I];

            //Rasterizer(CF,C_Scnd);
            Texture_Mapper(CF,C_Scnd);
        }
    } else if (C_NumVtx==3)
    {
        //Rasterizer(CF,C_Prim);
        Texture_Mapper(CF,C_Prim);
```

```
    }*/

    if (0)//C_Flags & Vtx_Left)
    {
        C_Scnd[0] = C_Prim[0];
        C_Scnd[2] = C_Prim[1];
        dword J = C_NumVtx;
        C_NumVtx = 3; // required for
        for(I=2;I<J;I++)
        {
            C_Scnd[1] = C_Scnd[2];
            C_Scnd[2] = C_Prim[I];

            //Rasterizer(CF,C_Scnd);
            //Texture_Mapper(C_Scnd);
        }
        C_NumVtx = J;
    } else {
        if (C_NumVtx>=3 && RasterFunc)
            //Texture_Mapper(CF,C_Prim);
            RasterFunc(C_Prim);
    }
}
```

```
// local variables
static byte            *l_pBibuf;
static BITMAPINFO  *l_pBi;
static HANDLE       l_WndThreadDone;
static byte            *l_pPage3 = 0;
static byte              l_pf;

#ifdef _FLY_OVER_WIN_CE
static HBITMAP      l_hBitmap = NULL;
static void            *l_pBits;
#endif

// global variables
HWND                g_hWnd;
dword                    g_xRes, g_yRes,g_Pitch;
word                *g_pVPage;


static byte IdentifyWindowPF()
{
#ifndef _FLY_OVER_WIN_CE

  struct MyBitmapInfo
  {
       BITMAPINFOHEADER bi;
       union
       {
          RGBQUAD colors[256];
          DWORD fields[256];
       };
  };
  MyBitmapInfo video;

  ZeroMemory(&video, sizeof(video));
  video.bi.biSize = sizeof(video.bi);
  video.bi.biBitCount = 0;
  HDC hdcDisplay = GetDC(NULL);
  HBITMAP hbm = CreateCompatibleBitmap(hdcDisplay,1,1);
  GetDIBits(hdcDisplay,hbm,0,1,NULL,(BITMAPINFO
*)&video,DIB_RGB_COLORS);
  GetDIBits(hdcDisplay,hbm,0,1,NULL,(BITMAPINFO
*)&video,DIB_RGB_COLORS);
  DeleteObject(hbm);
```

```
  ReleaseDC(NULL,hdcDisplay);

  // our case is ,framebuffer-32bpp, screen-16bpp
  if (video.bi.biCompression == BI_BITFIELDS &&
video.bi.biBitCount == 32)
  {
       // check bits
       if (video.fields[0] == 0x00ff0000 &&
            video.fields[1] == 0x0000ff00 &&
            video.fields[2] == 0x000000ff)
       {
            // ok, 32bpp, 8888
            return 32;
       }
  }
  else
  if (video.bi.biCompression == BI_BITFIELDS &&
video.bi.biBitCount == 24)
  {
       // check bits
       if (video.fields[0] == 0xff0000 &&
            video.fields[1] == 0x00ff00 &&
            video.fields[2] == 0x0000ff)
       {
            // ok, 24bpp, 888
            return 24;
       }
  }
  return 0;

#else
     return 0;
#endif
}



void InitDevice(dword xRes, dword yRes, HWND hWnd)
{
     dword bit_fields_32[3] = {0x00ff0000,   0x0000ff00,
0x000000ff};
     dword bit_fields_24[3] = {0xff0000,          0x00ff00,
     0x0000ff};
     dword bit_fields_16[3] = {0xf800,       0x07e0,
     0x001f};
     dword bit_fields_12[3] = {0x0f00,       0x00f0,
     0x000f};
```

```
    BITMAPINFOHEADER *l_pBih;

    g_xRes = xRes;
    g_yRes = yRes;
    g_Pitch = ((g_xRes+1)>>1) << 2; // amount of DWORDs
needed to store a scanline * sizeof(DWORD)
    g_hWnd = hWnd;

    // create the buffer ehre so that people can start
drawing before the other thread
    // goes running
    g_pVPage = new word [((g_Pitch * yRes)>>1) + 2];  //
Eyal: i added one for filler. // Yoni: with new pitch it
shouldnt be a problem but added 2 for fun


    // gdi
    l_pBibuf = new byte[sizeof(BITMAPINFOHEADER)+12];
    l_pBi = (BITMAPINFO *)l_pBibuf;
    l_pBih = &l_pBi->bmiHeader;

    // create an internal RGB DIB
    l_pBih->biSize = sizeof(BITMAPINFOHEADER);
    l_pBih->biPlanes = 1;
    l_pBih->biCompression = BI_BITFIELDS;
    l_pBih->biSizeImage = 0;
    l_pBih->biXPelsPerMeter = 0;
    l_pBih->biYPelsPerMeter = 0;
    l_pBih->biClrUsed = 0;
    l_pBih->biClrImportant = 0;

    l_pBih->biWidth = g_xRes;
    l_pBih->biHeight = -(sdword)g_yRes;

    l_pf = IdentifyWindowPF();

    l_pBih->biBitCount = (word)(l_pf ? l_pf : 16);

#ifndef _FLY_OVER_WIN_CE
    // l_pBit fields for conversion
    memcpy(l_pBi->bmiColors, l_pf ? (l_pf == 32 ?
bit_fields_32 : bit_fields_24) : bit_fields_16, 3*4);
    // create convert buffers if needed
    if (l_pf)
    {
```

```
            l_pPage3 = new byte[g_xRes*g_yRes*(l_pf>>3)];
      }

#else
      memcpy(l_pBi->bmiColors, l_pf ? (bit_fields_12) :
bit_fields_16, 3*4);
      if (l_pf)
      {
            ASSERT((g_xRes & 1) == 0);
            ULONG size = g_xRes*g_yRes*l_pf;
            size >>= 3;
            l_pPage3 = new byte[size + 1];
//          l_hBitmap = CreateBitmap( g_xRes, g_yRes, 1,
l_pBih->biBitCount, l_pPage3 );
      }
      else
      {
//          l_hBitmap = CreateBitmap( g_Pitch>>1, g_yRes, 1,
l_pBih->biBitCount, g_pVPage );
            HDC hDC = GetDC(g_hWnd);
            l_hBitmap = CreateDIBSection( hDC, l_pBi,
DIB_RGB_COLORS, &l_pBits, NULL, 0 );
            ReleaseDC( g_hWnd, hDC );
      }
#endif
}


void KillDevice()
{
      if (l_pPage3)
            delete l_pPage3;

      delete l_pBibuf;

      delete g_pVPage;

#ifdef _FLY_OVER_WIN_CE
      if (l_hBitmap) DeleteObject(l_hBitmap);
#endif
}


void ClearWindow()
{
      //memset(g_pVPage, 0x10, g_xRes*g_yRes*2);
      memset(g_pVPage, 0, g_Pitch*g_yRes);
```

```
}


// fps-compensator and d-time calculator
static const dword l_tmr_slp_ratio = 1000 / TMR_RESO;
static dword l_max_fps = 30;
static dword l_ticks_per_frame = TMR_RESO / l_max_fps;
static dword l_gltime = 0; // for gdtime calculation


void FlipWindow()
{
     // do we need to convert ?
     if (l_pf)
     {
          dword num;

          num = g_xRes*g_yRes;

          if (l_pf == 32)
          {
#ifndef _FLY_OVER_WIN_CE
               __asm
               {
                    push edi
                    push esi

                    mov ecx,num
                    mov edi,l_pPage3
                    mov esi,g_pVPage

                    lea edi,[edi+ecx*4]
                    lea esi,[esi+ecx*2]
                    xor ecx,-1
                    inc ecx

                    fast16232_inner:
                         mov ax,word ptr [esi+ecx*2]
                         shl eax,3
                         ror eax,8
                         shl ax,2
                         shl ah,3
                         rol eax,8

                         mov dword ptr [edi+ecx*4],eax
                         inc ecx
                    jnz fast16232_inner
```

```
                    pop esi
                    pop edi
                }
#else
                ULONG *pDest = (ULONG *)l_pPage3;
                USHORT *pSrc = (USHORT *)g_pVPage;
                ULONG x;
                for (dword i = 0; i < num; i++)
                {
                    x = *pSrc++;
                    *pDest++ = ((x & 0x1F) << 3) + ((x &
0x7E0) << 5) + ((x & 0xF800) << 8);
                }
#endif
            }
            else if (l_pf == 12)
            {
                UCHAR *pDest = (UCHAR *)l_pPage3;
                USHORT *pSrc = (USHORT *)g_pVPage;
                ULONG x, xx;
                num >>= 1;
                for (dword i = 0; i < num; i++)
                {
                    x = *pSrc++;
                    xx = *pSrc++;
                    *pDest++ = (UCHAR)(((x & 0x1E) >> 1) +
((x & 0x780) >> 3));
                    *pDest++ = (UCHAR)(((x & 0xF000) >> 12)
+ ((xx & 0x1E) << 3));
                    *pDest++ = (UCHAR)(((xx & 0x780) >> 7)
+ ((xx & 0xF000) >> 8));
                }
            }
            else if (l_pf == 24)
            {

            }
        }

        // flip
        HDC       hDC;
        hDC = GetDC(g_hWnd);


#ifndef _FLY_OVER_WIN_CE
```

```
     StretchDIBits( hDC,
                         0, 0, g_xRes, g_yRes,
                         0, 0, g_xRes, g_yRes,
                         l_pf ? (byte*)l_pPage3 :
(byte*)g_pVPage, l_pBi, DIB_RGB_COLORS, SRCCOPY);
#else
     HDC hDCMemory = CreateCompatibleDC(hDC);

//   HBITMAP hOldBmp2 = (HBITMAP)SelectObject(hDCMemory,
CreateCompatibleBitmap(hDC, g_xRes, g_yRes));

//   memset(g_pVPage, 0xEF, g_xRes * g_yRes * 2);
//   for (int i = 0; i < g_xRes * g_yRes * 3 /2; i++)
((UCHAR*)l_pPage3)[i] = (UCHAR)i;
//   if (l_pf) l_hBitmap = CreateBitmap( g_xRes, g_yRes, 1,
l_pf, l_pPage3 );
//   else l_hBitmap = CreateBitmap( g_Pitch >> 1, g_yRes,
1, 16, g_pVPage );
//   l_hBitmap = CreateDIBSection( hDC, l_pBi,
DIB_RGB_COLORS, &l_pBits, NULL, 0 );
     memcpy( l_pBits, g_pVPage, g_xRes * g_yRes * 2);

     HBITMAP hOldBmp = (HBITMAP)SelectObject(hDCMemory,
l_hBitmap);

//   HBRUSH br = CreateSolidBrush( 0x000FFFF0 );
//   RECT rec; rec.top = 10; rec.left = 10; rec.bottom =
100; rec.right = 100;
//   FillRect( hDCMemory, &rec, br);

     BitBlt(hDC, 0, 0, g_xRes, g_yRes, hDCMemory, 0, 0,
SRCCOPY);

     SelectObject(hDCMemory, hOldBmp);
     DeleteDC(hDCMemory);

//   DeleteObject( hOldBmp );
//   DeleteObject( l_hBitmap ); l_hBitmap = NULL;
#endif

     ReleaseDC(g_hWnd, hDC);


     // timing

     // calculate global-delta-time (frame time)
     g_gdtime = g_timer - l_gltime;
```

```
     g_fgdtime = (float)g_gdtime / (float)TMR_RESO;
     l_gltime = g_timer;

     // fps compensator
     if ( g_gdtime < l_ticks_per_frame )
          Sleep((l_ticks_per_frame-
g_gdtime)*l_tmr_slp_ratio);
}
```

Module: Raster.cpp

```
// tri-mapper vars
flat_intrp d12,d13,d23;
long Ptr__;

inline void Fist__(long *i,float f)
{
     *i = (long)(f+0.5f); // slow C code

}

// this is actually a slow 16-bit flat inner
static void Flat_Inner16()
{
// Original ASM inner loop

     if (X2_<=X1_) return;

     //word *p = (word *)Ptr__;
     //p[X1_] = FColor_;
     //p[X2_] = FColor_;
     //return;


#ifndef _FLY_OVER_WIN_CE
     __asm
     {
          Mov EDI,[Ptr__]
          Mov EBX,[X1_]
          LEA EDI,[EDI+EBX*2]
          Mov AX,[FColor_]
          Mov ECX,[X2_]
          Sub ECX,EBX
          Rep StoSW
     }
#else
     // slow C code
     long x;
     word *p = (word *)Ptr__ + X1_;
     for(x=X1_;x<X2_;x++)
          *p++ = *p + FColor_;
     //long x;
#endif
}
```

```
static void Flat_Inner16T()
{
     if (X2_<=X1_) return;

#ifndef _FLY_OVER_WIN_CE
     // x86 non-MMX 50% transparent 16bit flat inner
     __asm
     {
          Mov EDI,[Ptr__]
          Mov EBX,[X1_]
          Mov ECX,[X2_]
          Mov AX,[FColor_]
          LEA EDI,[EDI+ECX*2]
          And AX,0F7DEh
          Sub EBX,ECX
          Shr AX,1
          Mov ECX,EBX
          INNER:
               Mov BX,[EDI+ECX*2]
               And BX,0F7DEh
               Shr BX,1
               Add BX,AX
               Mov [EDI+ECX*2],BX
               Inc ECX
          JNZ short INNER
     }
#else
     // slow C code
     long x;
     word addCol = (FColor_ & 0xF7DE) >> 1;
     word *p = (word *)Ptr__ + X1_;
     for(x=X1_;x<X2_;x++)
          *p++ = ((*p & 0xF7DE) >> 1) + addCol;
     //long x;
     //word *p = (word *)Ptr__;
     //p[X1_] = FColor_;
     //p[X2_] = FColor_;
#endif
}

static void (*Flat_Inner)();

void FAST_Flat_Outer(flat_intrp *Left,flat_intrp
*Right,long H_)
{
     if (H_<=0) return;
     do
```

```
    {
        Fist__(&X1_, Left->ix-0.499f);
        Fist__(&X2_,Right->ix-0.499f);

        Flat_Inner();

        Left->ix += Left->dxdy;
        Right->ix += Right->dxdy;

        Ptr__ += g_VS.Pitch;
    } while (--H_);

}

void FAST_Flat()
{
    long Y1,Y2,Y3,dY12,dY13,dY23;
    float dx12,dy12,subY;
    float Merid;

    Vertex *T;

    //B and C might not be Y-sorted.
    if (A_->PY>B_->PY) {T=A_; A_=B_; B_=T;}
    if (A_->PY>C_->PY) {T=A_; A_=C_; C_=T;}
    if (B_->PY>C_->PY) {T=B_; B_=C_; C_=T;}

    // ok. now, get the polygon drawn.
    // quantize Y values. (ceil(Y))
    Fist__(&Y1,A_->PY+0.499f);
    Fist__(&Y2,B_->PY+0.499f);
    Fist__(&Y3,C_->PY+0.499f);
    dY12 = Y2-Y1; dY13 = Y3-Y1; dY23 = Y3-Y2;

    // calculate d13 deltas
    if (dY13>0)
    {
        subY = (float)Y1-A_->PY;
        d13.dxdy = (C_->PX-A_->PX)/(C_->PY-A_->PY);
        d13.ix = A_->PX + subY*d13.dxdy;

        if (dY12>0)
        {
            dx12 = B_->PX-A_->PX;
            dy12 = B_->PY-A_->PY;
            d12.dxdy = dx12/dy12;
            d12.ix = A_->PX + subY * d12.dxdy;
```

```
                Merid = dx12 - d13.dxdy * dy12;
            } else {Merid = B_->PX-A_->PX;}
            if (dY23>0)
            {
                d23.dxdy = (C_->PX-B_->PX)/(C_->PY-B_->PY);
                subY = (float)Y2-B_->PY;
                d23.ix = B_->PX + subY*d23.dxdy;
            }
        } else return;

        Ptr__ = ((long)g_VS.FB) + Y1 * g_VS.xRes * 2;

        if (Merid>0)
        {
            FAST_Flat_Outer(&d13,&d12,dY12);
            FAST_Flat_Outer(&d13,&d23,dY23);
        } else {
            FAST_Flat_Outer(&d12,&d13,dY12);
            FAST_Flat_Outer(&d23,&d13,dY23);
        }
}

void putpixel(Vertex *V)
{
        //Ptr__ = ((long)g_VS.FB) + Y1 * g_VS.xRes * 2;
        word * w = ((word *)g_VS.FB) + (int)V->PX  + ((int)V-
>PY) * g_VS.xRes;

        word r = *w;
        if ((!r) || r > FColor_) *w = FColor_;
}

void RasterizerSetOP(dword Opcode)
{
        switch (Opcode)
        {
        case 0:
            Flat_Inner = Flat_Inner16;
        break;
        case ROP_Transparent:
            Flat_Inner = Flat_Inner16T;
        break;
        }
}

void RasterizerSetColor(word c)
{
```

```
        FColor_ = c;
}

void Rasterizer(Vertex **VA)
{

        for(mword i=2; i<C_NumVtx; i++)
        {
                A_ = VA[0];
                B_ = VA[i-1];
                C_ = VA[i];
        //FColor_ = Palette[FillColor_];
        //if (GetAsyncKeyState('W'))
                FAST_Flat();
        }
        //else {
//              putpixel(A_);
//              putpixel(B_);
//              putpixel(C_);
//      }

}
```

Module: Tex.cpp

```
#ifndef _FLY_OVER_WIN_CE
extern "C"
{
     // bihi.asm
     extern void         P_Texture_16(void);
     extern void         P_Texture_Transparent_16(void);
     extern dword   CodeStart, CodeSize; //smc
};
#endif


static    Bi_Triangle    BTriangle[3];
dword     BTriangleD = (dword)BTriangle,
          DestinationPageD, CurrentTextureD, BPSL;


static dword OldProtect;
dword ddu_computed;
dword g_lvldiff,dufactor;

float drzdx,duzdx[12],dvzdx[12];
float drzdy,duzdy[12],dvzdy[12];


void CalculateDDU(Vertex **VA)
{
     // calculate duzdx,dvzdx
     register Vertex *A = VA[0];
     register Vertex *B = VA[1];
     register Vertex *C = VA[2];

     float dxy = 1.0f / ((C->PY-A->PY)*(B->PX-A->PX)-(B-
>PY-A->PY)*(C->PX-A->PX));
     drzdx     =         ((C->PY-A->PY)*(B->RZ-A->RZ)-(B-
>PY-A->PY)*(C->RZ-A->RZ)) * dxy;
     dxy *= (TEXTURE_MUL) / (1<<dufactor);
     duzdx[0] = ((C->PY-A->PY)*(B->UZ-A->UZ)-(B->PY-A-
>PY)*(C->UZ-A->UZ)) * dxy;
     dvzdx[0] = ((C->PY-A->PY)*(B->VZ-A->VZ)-(B->PY-A-
>PY)*(C->VZ-A->VZ)) * dxy;
     DWORD I;

     for(I=1;I<12;I++)
     {
```

```
            duzdx[I] = duzdx[I-1]*2.0f;
            dvzdx[I] = dvzdx[I-1]*2.0f;
      }
      ddu_computed = 0;
}

void EnableFillerSMC()
// Enable writing to the mappers code-segment
{
#ifndef _FLY_OVER_WIN_CE
      VirtualProtect( (void *)CodeStart,
                        CodeSize,
                        PAGE_EXECUTE_READWRITE,
                        &OldProtect);
#endif
}

void DisableFillerSMC()
// simply return to prior VirtualProtect Situation
{
#ifndef _FLY_OVER_WIN_CE
      dword OldOldProtect;

      VirtualProtect( (void *)CodeStart,
                        CodeSize,
                        OldProtect,
                        &OldOldProtect);
#endif
}

static Vertex *VSwap[12];

void Texture_Mapper(Face *F,Vertex **VA)
{
// before removing eyal+gilad memory trick
/*    if (0 && GetAsyncKeyState('P'))
// end - before removing eyal+gilad memory trick
      {
            Vertex *A = VA[0];
            Vertex *B = VA[1];
            Vertex *C = VA[2];

            BTriangle[0].FX=A->PX;
            BTriangle[0].FY=A->PY;
            BTriangle[0].X=(int)A->PX;
            BTriangle[0].Y=(int)A->PY;
            BTriangle[0].Z=A->RZ;
```

```
	BTriangle[0].U=A->UZ*64.0f;
	BTriangle[0].V=A->VZ*64.0f;

	BTriangle[1].FX=B->PX;
	BTriangle[1].FY=B->PY;
	BTriangle[1].X=(int)B->PX;
	BTriangle[1].Y=(int)B->PY;
	BTriangle[1].Z=B->RZ;
	BTriangle[1].U=B->UZ*64.0f;
	BTriangle[1].V=B->VZ*64.0f;

	BTriangle[2].FX=C->PX;
	BTriangle[2].FY=C->PY;
	BTriangle[2].X=(int)C->PX;
	BTriangle[2].Y=(int)C->PY;
	BTriangle[2].Z=C->RZ;
	BTriangle[2].U=C->UZ*64.0f;
	BTriangle[2].V=C->VZ*64.0f;


	CurrentTextureD = (dword)(F->Txtr);
	P_Texture_16();

	return;
}

long i;
for(i=0;i<C_NumVtx;i++)
	VSwap[i] = VA[C_NumVtx-1-i];

test_texture(F,VSwap,C_NumVtx);
return;

//if
BOOL doAgain = true;
while (doAgain)
{
	int mny = 0, ly = 2, ry = 1;
	if (VA[mny]->PY > VA[1]->PY)
	{
		mny = 1; ly = 0; ry = 2;
	}
	if (VA[mny]->PY > VA[2]->PY)
	{
		mny = 2; ly = 1; ry = 0;
	}
```

```
          if ((VA[mny]->PY == VA[ly]->PY)&&(VA[mny]->PY ==
VA[ry]->PY)) return;

          float dx1 = VA[ry]->PX - VA[mny]->PX;
          float dy1 = VA[ry]->PY - VA[mny]->PY;

          float dx2 = VA[ly]->PX - VA[mny]->PX;
          float dy2 = VA[ly]->PY - VA[mny]->PY;

          //if ( (dx1 / dy1) > (dx2 / dy2) ) // Bizayon.
          if ( (dx1 * dy2) > (dx2 * dy1) )
          {
               test_texture(F, VA, 3);
          } else
          {
               Vertex *V[3];
               V[0] = VA[2];
               V[1] = VA[1];
               V[2] = VA[0];
               test_texture(F, V, 3);
          }

          doAgain = false;
     }
*/
}

#ifdef _FLY_OVER_WIN_CE
#undef ASSERT
#endif
#define ASSERT(x)



struct VInt
{
//   Vertex *Vtx;
     long X,Y;
};

void test_texture(Face *F,Vertex **VA,dword nVtx)
{
//   return;
     // CW->CCW
//   Vertex *V_;
//   V_ = VA[1]; VA[1]=VA[2]; VA[2] = V_;
```

```
/*   dword     i;
     long upLeftID, upRightID;
     float     lowY = (float)g_yRes;

     long partsAmount = 0;
     _parts *mp = (_parts *)(&txtrstruct.addXL1);

     VInt VI[16];
//   VInt VS[8];

     BOOL zero = false;
     for(i=0;i<nVtx;i++)
     {
//        VI[i].Vtx=VA[i];
          VI[i].X=(long)VA[i]->PX;
          VI[i].Y=(long)VA[i]->PY;

          if (VI[i].X == 0) zero = true;
     }

     // find minimal-Y vertex
     upLeftID = 0;
     for (i = 0; i < nVtx; ++i)
     {
          if (VI[i].Y < VI[upLeftID].Y)
          {
               upLeftID = i;
          }
          else if (VI[i].Y == VI[upLeftID].Y)
          {
               if (VI[i].X < VI[upLeftID].X)
               {
                    upLeftID = i;
               }
          }
     }

     upRightID = upLeftID;
     i = upRightID +1;
     if (i >= nVtx) i = 0;
     while (VI[i].Y == VI[upLeftID].Y)
     {
          upRightID = i++;
          if (i >= nVtx) i = 0;
          if (upRightID == upLeftID) // one scan line
polygon
```

```
          {
               upLeftID = 0;
               for (long k = 0; k < nVtx; k++)
               {
                    if (VI[upLeftID].X > VI[k].X) upLeftID
= k;
               }
               mp->addXL = 0;
               mp->addXR = 0;
               mp->addZ = 0;
               mp->addUZ = 0;
               mp->addVZ = 0;
               mp->D = -1;
               partsAmount = 1;
               break;
          }
     }
     //  upest left vertex is in upLeftID, and upRightID
...

     long maxY = VI[upRightID].Y;

     i = upRightID +1;
     if (i >= nVtx) i = 0;

     while (maxY <= VI[i].Y)
     {
          maxY = VI[i++].Y;
          if (i >= nVtx) i = 0;
          if (i == upLeftID) break;
     }


     long leftID = upLeftID, rightID = upRightID,
nextLeftID, nextRightID;
     BOOL leftDone = false, rightDone = false;
     long minY = VI[leftID].Y;
     long dLeftY;
     while (minY != maxY)
     {
          if ( partsAmount > 1 ) mp++;
          else if ( partsAmount == 1 ) mp =
&(txtrstruct.parts[0]);

          nextLeftID = leftID -1;
          if (nextLeftID < 0) nextLeftID = nVtx -1;
          if (VI[nextLeftID].Y <= VI[leftID].Y)
```

```
            {
                while (VI[nextLeftID].Y == VI[leftID].Y)
                {
                    nextLeftID--;
                    if (nextLeftID < 0) nextLeftID = nVtx -
1;
                }
                ASSERT(VI[nextLeftID].Y < VI[leftID].Y);
//              {
//                  partsAmount > 20);
//                  nextLeftID = leftID;
//                  leftDone = true;
//              }
            }

            nextRightID = rightID +1;
            if (nextRightID >= nVtx) nextRightID = 0;
            if (VI[nextRightID].Y <= VI[rightID].Y)
            {
                while (VI[nextRightID].Y == VI[rightID].Y)
                {
                    nextRightID++;
                    if (nextRightID >= nVtx) nextRightID =
0;
                }
                ASSERT(VI[nextRightID].Y < VI[rightID].Y);
            }

            dLeftY = (VI[nextLeftID].Y - VI[leftID].Y);
            mp->addXL = ((VI[nextLeftID].X -
VI[leftID].X)*65536) /dLeftY *2;
            mp->addXR = ((VI[nextRightID].X -
VI[rightID].X)*65536) /(VI[nextRightID].Y - VI[rightID].Y)
*2;
            mp->addXL += g_xRes *65536 *2;
            mp->addXR += g_xRes *65536 *2;

            mp->addZ = (VA[nextLeftID]->RZ - VA[leftID]->RZ)
/dLeftY;
            mp->addUZ = (VA[nextLeftID]->UZ - VA[leftID]-
>UZ)*TEXTURE_MUL /dLeftY;
            mp->addVZ = (VA[nextLeftID]->VZ - VA[leftID]-
>VZ)*TEXTURE_MUL /dLeftY;

            if (VI[nextLeftID].Y > VI[nextRightID].Y)
            {
                mp->D = VI[nextRightID].Y - minY;
```

```
                minY = VI[nextRightID].Y;
                rightID = nextRightID;
            }
            else if (VI[nextLeftID].Y < VI[nextRightID].Y)
            {
                mp->D = VI[nextLeftID].Y - minY;
                minY = VI[nextLeftID].Y;
                leftID = nextLeftID;
            }
            else
            {
                mp->D = VI[nextLeftID].Y - minY;
                minY = VI[nextLeftID].Y;
                leftID = nextLeftID;
                rightID = nextRightID;
            }
            partsAmount++;
            ASSERT(partsAmount > 20);
        }

        mp->D++;

        txtrstruct.moreParts = partsAmount -1;
        txtrstruct.bmp = F->Txtr;
        txtrstruct.xRes = g_xRes;
        txtrstruct.U1 = (dword)(VA[upLeftID]->U *TEXTURE_MUL);
       txtrstruct.V1 = (dword)(VA[upLeftID]->V *TEXTURE_MUL);
        txtrstruct.DeltaScr1 = (dword)(g_pVPage +
VI[upLeftID].X + (VI[upLeftID].Y * g_xRes));
        txtrstruct.DeltaScr2 = (dword)(g_pVPage +
VI[upRightID].X + (VI[upLeftID].Y * g_xRes));
        txtrstruct.Z1 = VA[upLeftID]->RZ;
        txtrstruct.UZ1 = VA[upLeftID]->UZ *TEXTURE_MUL;
        txtrstruct.VZ1 = VA[upLeftID]->VZ *TEXTURE_MUL;

// PATCH:
//   txtrstruct.U1 = txtrstruct.UZ1 / txtrstruct.Z1;
//   txtrstruct.V1 = txtrstruct.VZ1 / txtrstruct.Z1;
// PATCH:


        txtrstruct.adZ = drzdx;
        txtrstruct.adUZ = duzdx[g_lvldiff];
        txtrstruct.adVZ = dvzdx[g_lvldiff];
        txtrstruct.adZdy = drzdy;
        txtrstruct.adUZdy = duzdy[g_lvldiff];
        txtrstruct.adVZdy = dvzdy[g_lvldiff];
```

```
//   txtrstruct.adZdy = 0;
//   txtrstruct.adUZdy = txtrstruct.addUZ1;
//   txtrstruct.adVZdy = txtrstruct.addVZ1;

     {
          Vertex *A = VA[0];
          Vertex *B = VA[1];
          Vertex *C = VA[2];

          double divDxy = ((C->PX-A->PX)*(B->PY-A->PY))-
((B->PX-A->PX)*(C->PY-A->PY));
          double dxy = 1.0 / divDxy;
          //txtrstruct.adZdy =       ((C->PX-A->PX)*(B->RZ-
A->RZ)-(B->PX-A->PX)*(C->RZ-A->RZ)) * dxy;
          dxy *= (TEXTURE_MUL);
          txtrstruct.adUZdy = ((C->PX-A->PX)*(B->UZ-A->UZ)-
(B->PX-A->PX)*(C->UZ-A->UZ)) * dxy;
          txtrstruct.adVZdy = ((C->PX-A->PX)*(B->VZ-A->VZ)-
(B->PX-A->PX)*(C->VZ-A->VZ)) * dxy;
//        float dxy = 1.0 / ((VI[2].Y-VI[0].Y)*(VI[1].X-
VI[0].X)-(VI[1].Y-VI[0].Y)*(VI[2].X-VI[0].X));
//        txtrstruct.adZ =       ((VI[2].Y-VI[0].Y)*(B->RZ-
A->RZ)-(VI[1].Y-VI[0].Y)*(C->RZ-A->RZ)) * dxy;
//        dxy *= (TEXTURE_MUL);
//        txtrstruct.adUZ = ((VI[2].Y-VI[0].Y)*(B->UZ-A-
>UZ)-(VI[1].Y-VI[0].Y)*(C->UZ-A->UZ)) * dxy;
//        txtrstruct.adVZ = ((VI[2].Y-VI[0].Y)*(B->VZ-A-
>VZ)-(VI[1].Y-VI[0].Y)*(C->VZ-A->VZ)) * dxy;
     }

//   txtrstruct.UZ1 += (VA[upLeftID]->PY -
((float)VI[upLeftID].Y)) *txtrstruct.adUZdy;
//   txtrstruct.VZ1 += (VA[upLeftID]->PY -
((float)VI[upLeftID].Y)) *txtrstruct.adVZdy;

     txtrstruct.adZ16 = txtrstruct.adZ * 16;
     txtrstruct.adUZ16 = txtrstruct.adUZ * 16;
     txtrstruct.adVZ16 = txtrstruct.adVZ * 16;

     if (upLeftID != upRightID)
     {
          upLeftID = upLeftID;
     }


//   txtrstruct.U1 = txtrstruct.DeltaScr1;
//   txtrstruct.V1 = txtrstruct.DeltaScr1;
```

```
     txtrstruct.bmp = (word *)F->Txtr;

     // before removing eyal+gilad memory trick

               //   word *wptr = (word *)F->Txtr;
               //   txtrstruct.bmp = wptr;+64*64*4;

     // end - before removing eyal+gilad memory trick

     // For debuging:
     if (zero = 0)
     {
          static short tBmp[64*64+1];
          memset(tBmp, (BYTE)(((long)txtrstruct.bmp) >> 8)
| 13, (64*64+1)*2);
          txtrstruct.bmp = &tBmp;
     }

     texture_per64();
}*/

/*   Vertex    *pVerts[8];
     dword rVtx = nVtx-lowID;
     memcpy(VS,VI+lowID,rVtx*sizeof(VInt));
     memcpy(VS+rVtx,VI,lowID*sizeof(VInt));

//   void *bmp;           // bitmap, should be aligned to
0x20000   0    *
//   long    DeltaScr1,  // addr of first pixel to draw
4    *
//        DeltaScr2,              // addr of last pixel in
first line       8    *
//        addXL1,                 // add to left offset
12
//        addXR1,                 // add to right offset
16
//        D1;                     // size of first part of
the poly         20
//   float
//        addZ1,                  // add to left (1/Z)
24
//        addUZ1,                 // add to left (U/Z)
28
//        addVZ1,                 // add to left (V/Z)
32
//   long
```

```
//        U1, V1;                    // first point cords
36
//   float
//        adZ16,                     // add after every 16
pixels to (1/Z)     40   *
//        adUZ16,           // add after every 16 pixels to
(U/Z)     44   *
//        adVZ16,           // add after every 16 pixels to
(V/Z)     48   *
//        adZ,                       // add after every pixel
to (1/Z)          52   *
//        adUZ,             // add after every pixel to
(U/Z)          56   *
//        adVZ,             // add after every pixel to
(V/Z)          60   *
//        Z1,                 // first (1/Z)
64
//        UZ1,                // first (U/Z)
68
//        VZ1;                // first (V/Z)
72
//   long moreParts;     // how much parts to the polygon(
-1)      76
//
//   struct _parts
//   {
//        addXL,      // add to left offset
80+24K *
//        addXR,                     // add to right offset
*
//        D,                              // size of part
*
//        addZ,                      // add to left (1/Z)
*
//        addUZ,              // add to left (U/Z)
*
//        addVZ,              // add to left (V/Z)
*
//   } parts[20];

     long partsAmount = 0;
     _parts *mp = (_parts *)(&txtrstruct.addXL1);

     // verify that the total height is nonzero
     //if (p[0][1] == p[2][1]) return;

     long leftID = lowID, rightID = lowID;
```

```
     long nextLeftID = leftID, nextRightID = rightID;

     if (++nextLeftID >= nVtx) nextLeftID = 0;
     if (--nextRightID < 0) nextRightID = nVtx-1;

     txtrstruct.DeltaScr1 = (dword)(g_pVPage + VS[lowID].X
+ (VS[lowID].Y * g_xRes));

     if (VS[lowID].Y == VS[rightID].Y)
          txtrstruct.DeltaScr2 = (dword)(g_pVPage +
VS[leftID].X + (VS[leftID].Y * g_xRes));
     else
          txtrstruct.DeltaScr2 = txtrstruct.DeltaScr1;

     txtrstruct.bmp = F->Txtr;
     txtrstruct.U1 = (dword)(A->U *64*256);
     txtrstruct.V1 = (dword)(A->V *64*256);

     bool go = true;
     while (go)
     {
          bool addPart;
          addPart = false;
          txtrstruct.addXL1 = ((p[2][0] - p[0][0]) *65536)
/ (p[2][1] - p[0][1]) *2;
          txtrstruct.addXL2 = ((p[2][0] - p[1][0]) *65536)
/ (p[2][1] - p[1][1]) *2;
          txtrstruct.D1 = p[2][1] - p[0][1];

          txtrstruct.addZ1 = (C->RZ - A->RZ) / (p[2][1] -
p[0][1]);
          txtrstruct.addUZ1 = ((C->UZ - A->UZ) *64*256) /
(p[2][1] - p[0][1]);
          txtrstruct.addVZ1 = ((C->VZ - A->VZ) *64*256) /
(p[2][1] - p[0][1]);


     }

     if (p[0][1] == p[1][1])
     {
          txtrstruct.DeltaScr2 = (dword)(g_pVPage + B->PX
+(B->PY * g_xRes));
          txtrstruct.addXL1 = ((p[2][0] - p[0][0]) *65536)
/ (p[2][1] - p[0][1]) *2;
          txtrstruct.addXL2 = ((p[2][0] - p[1][0]) *65536)
/ (p[2][1] - p[1][1]) *2;
```

```
          txtrstruct.D1 = p[2][1] - p[0][1];

          txtrstruct.addZ1 = (C->RZ - A->RZ) / (p[2][1] -
p[0][1]);
          txtrstruct.addUZ1 = ((C->UZ - A->UZ) *64*256) /
(p[2][1] - p[0][1]);
          txtrstruct.addVZ1 = ((C->VZ - A->VZ) *64*256) /
(p[2][1] - p[0][1]);
          if (p[1][0] - p[0][0] != 0)
          {
               txtrstruct.adZ = (C->RZ - A->RZ) / (p[1][0]
- p[0][0]);
               txtrstruct.adUZ = ((C->UZ - A->UZ) *64*256)
/ (p[1][0] - p[0][0]);
               txtrstruct.adVZ = ((C->VZ - A->VZ) *64*256)
/ (p[1][0] - p[0][0]);
               txtrstruct.adZ16 = txtrstruct.adZ * 16;
               txtrstruct.adUZ16 = txtrstruct.adUZ16 * 16;
               txtrstruct.adVZ16 = txtrstruct.adVZ16 * 16;
          }
          else
          {
               txtrstruct.adZ = 0;
               txtrstruct.adUZ = 0;
               txtrstruct.adVZ = 0;
               txtrstruct.adZ16 = 0;
               txtrstruct.adUZ16 = 0;
               txtrstruct.adVZ16 = 0;
          }
     }
     else
     {
          txtrstruct.DeltaScr2 = txtrstruct.DeltaScr1;
          if (p[1][1] == p[2][1])
          {
               txtrstruct.addXL1 = ((p[2][0] - p[0][0])
*65536) / (p[2][1] - p[0][1]) *2;
               txtrstruct.addXL2 = ((p[2][0] - p[1][0])
*65536) / (p[2][1] - p[1][1]) *2;
               txtrstruct.D1 = p[2][1] - p[0][1];

               txtrstruct.addZ1 = (C->RZ - A->RZ) /
(p[2][1] - p[0][1]);
               txtrstruct.addUZ1 = ((C->UZ - A->UZ)
*64*256) / (p[2][1] - p[0][1]);
               txtrstruct.addVZ1 = ((C->VZ - A->VZ)
*64*256) / (p[2][1] - p[0][1]);
```

```
            }
            else
            {

            }
        }


        texture_per64();*/
}

// Perspective-corrected Subpixeling/Subtexeling 16bit
Texture mapper
// Advanced version scanconverts ngons directly (operative)
// Simple version Triangulates input Polygons. (operative)
// Next: Interfacing version usable with Eyal's
Texturemapper
static Vertex *RR_VA_[25],**RR_VA=RR_VA_+1;
static long RR_Y_[25],*RR_Y = RR_Y_+1;
static dword RR_NumVerts;
static word *RR_TexturePtr;
static dword RR_SectionHeight;
static dword RR_GPositive;
static float LeftX,RightX;
static float LeftUZ,LeftVZ,LeftRZ;
static float LeftDX,RightDX;
static float LeftDUZ,LeftDVZ,LeftDRZ;
static float IntUZ,IntVZ,IntRZ;
static float drzdx_,duzdx_,dvzdx_;
static float drzdx_16,duzdx_16,dvzdx_16;
static float Inv16[15] = {
     1.0f/1.0f, 1.0f/2.0f, 1.0f/3.0f, 1.0f/4.0f, 1.0f/5.0f,
     1.0f/6.0f, 1.0f/7.0f, 1.0f/8.0f, 1.0f/9.0f,
1.0f/10.0f,
     1.0f/11.0f, 1.0f/12.0f, 1.0f/13.0f, 1.0f/14.0f,
1.0f/15.0f
};
static word *Scanline,*ScanPtr;
static long Width;

static Texture RR_Texture;
static mword RR_MaskU, RR_MaskV;

#define RR_TScale (65536.0f)
float RR_TScaleU, RR_TScaleV;

void RR_SetTexture(Texture *Tx)
```

```
{
     if (Tx)
     {
          memcpy(&RR_Texture, Tx, sizeof(Texture));
          RR_TexturePtr = (word *)Tx->_data;
          RR_MaskU = ((1<<Tx->_l2xRes)-1)<<16;
          RR_MaskV = ((1<<Tx->_l2yRes)-1)<<16;
          RR_TScaleU = 65536.0*(1<<Tx->_l2xRes);
          RR_TScaleV = 65536.0*(1<<Tx->_l2yRes);
     } else RR_TexturePtr = NULL; // disables the mapper
}

// Automatic inner loop setting
/*void RR_SetTexture(Texture *Tx)
{
     RR_SetTextureParams(Tx);

     if (RR_Texture._stateFlags & TSF_
}*/


// 28.7.01: making an attempt to allow 'plugin' innerloops.
// first generalize usage of Eyal's and the normal mapper
void (*RR_OuterInit)();
void (*RR_OuterLoop)();
void (*RR_InnerLoop)();

dword RRGrads(Vertex *A,Vertex *B,Vertex *C)
{
     float dxy = 1.0f / (((C->PY-A->PY)*(B->PX-A->PX))-((B-
>PY-A->PY)*(C->PX-A->PX)));
     drzdx_ = ((C->PY-A->PY)*(B->RZ-A->RZ)-(B->PY-A-
>PY)*(C->RZ-A->RZ)) * dxy;
     drzdx_16 = drzdx_ * 16.0f;
     //dxy *= RR_TScale;

     duzdx_ = ((C->PY-A->PY)*(B->UZ-A->UZ)-(B->PY-A-
>PY)*(C->UZ-A->UZ)) * dxy * RR_TScaleU;
     duzdx_16 = duzdx_ * 16.0f;

     dvzdx_ = ((C->PY-A->PY)*(B->VZ-A->VZ)-(B->PY-A-
>PY)*(C->VZ-A->VZ)) * dxy * RR_TScaleV;
     dvzdx_16 = dvzdx_ * 16.0f;


     return 0;
```

```
}


// An advanced version of RR_InnerLoop, coded in x86
assembly. This function should be optimized// for Pentium
Pro/2/3 Processors.

// OPT -> Dualpixel processing aligned to 4 bytes
// OPT -> efficient CPU/FPU sync
static void RR_InnerLoop_Ax86P2opt()
{
     static const float one = 1.0f;
     static float rrz;
     static long u0,v0,u1,v1;
/*   __asm {
          ; Preperations for Inner
          ; FPU state ST(0..7)
          fld [IntRZ]          ; RZ
          fld one              ; RZ, 1
          fdiv ST,ST(1)        ; RZ, Z
          fld drzdx_16         ; RZ, Z, dRZ
          faddp ST(2),ST       ; Z, RZ+dRZ
          fxch ST,ST(1)        ; RZ+dRZ, Z
          fstp IntRZ           ; Z
          fld [dvzdx_16]       ; Z, dVZ
          fld [IntUZ]          ; Z, dVZ, UZ
          fld [IntVZ]          ; Z, dVZ, UZ, VZ
          fld [duzdx_16]       ; Z, dVZ, UZ, VZ, dUZ
          fxch ST,ST(4)        ; dUZ, dVZ, UZ, VZ, Z
          fadd ST,ST(2)        ; dUZ+UZ, dVZ, UZ, VZ, Z
          fxch ST,ST(1)        ; dVZ, dUZ+UZ, UZ, VZ, Z
          fadd ST,ST(3)        ; dVZ+VZ, dUZ+UZ, UZ, VZ, Z
          fstp IntVZ             ; dUZ+UZ, UZ, VZ, Z
          fstp IntUZ           ; UZ, VZ, Z
          fxch ST,ST(2)        ; Z, VZ, UZ
          fmul ST(1),ST        ; Z, V, UZ
          fmulp ST(2),ST       ; V, U
          fistp [v0]           ; U
          fistp [u0]           ; /
     }

     __asm {
          emms ; EMPTY(RESET) MMX REGISTER STATE
     }*/
}
```

```
static void RR_InnerLoop_ZCK()
{
     // Affine-16 Inner: preparation
     static float rrz;
     static long u0,v0,u1,v1;
     rrz = 1.0f / IntRZ;
     u0 = (long)(IntUZ * rrz);// & 0x3FFFFF;
     v0 = (long)(IntVZ * rrz);// & 0x3FFFFF;
     IntRZ += drzdx_16;
     IntUZ += duzdx_16;
     IntVZ += dvzdx_16;

     rrz = 1.0f / IntRZ;
     u1 = (long)(IntUZ * rrz);// & 0x3FFFFF;
     v1 = (long)(IntVZ * rrz);// & 0x3FFFFF;
     IntRZ += drzdx_16;
     IntUZ += duzdx_16;
     IntVZ += dvzdx_16;

     static long du,dv,W16;
     static long Counter;

     if (Width>=16)
     {
          W16 = Width>>4;

          // affine-16 inner outer
          do {
               rrz = 1.0f / IntRZ;
               du = (u1-u0)>>4;
               dv = (v1-v0)>>4;
               // affine-16 inner inner
               Counter = 16;
               do {
                    register word w =
RR_TexturePtr[((u0&0xFF0000)>>16)+((v0&0xFF0000)>>(16-
RR_Texture._12xRes))];
                    if (w) *ScanPtr++ = w; else ScanPtr++;
                    u0 += du;
                    v0 += dv;
               } while (--Counter);
               u1 = (long)(IntUZ * rrz);
               v1 = (long)(IntVZ * rrz);
               IntRZ += drzdx_16;
               IntUZ += duzdx_16;
               IntVZ += dvzdx_16;
          } while (--W16);
```

```
            Width &= 0xF;
            if (!Width) return;
      }

      du = (u1-u0)>>4;
      dv = (v1-v0)>>4;
      do {
            //*ScanPtr++ =
RR_TexturePtr[((u0&0xFF0000)>>16)+((v0&0xFF0000)>>(16-
RR_Texture._l2xRes)];
            //*ScanPtr++ += 0x7bef;
            register word w =
RR_TexturePtr[((u0&0xFF0000)>>16)+((v0&0xFF0000)>>(16-
RR_Texture._l2xRes))];
            if (w) *ScanPtr++ = w; else ScanPtr++;
            u0 += du;
            v0 += dv;
      } while (--Width);
}

// This uses Affine-16 bilinear interpolation,
// also it interpolates last segment out of polygon bounds,
this has to be
// fixed. (ask Rage/IMR)
static void RR_InnerLoop_Standard()
{
      // slow inner
      /*do {
            float rrz = 1.0f / IntRZ;
            long u = ((long)(IntUZ * rrz)>>16) & 0x3F;
            long v = ((long)(IntVZ * rrz)>>16) & 0x3F;
            *ScanPtr++ = RR_TexturePtr[(u+(v<<6))];
            IntRZ += drzdx_;
            IntUZ += duzdx_;
            IntVZ += dvzdx_;
      } while (--Width);
      return;*/

      // Affine-16 Inner: preparation
      static float rrz;
      static long u0,v0,u1,v1;
      rrz = 1.0f / IntRZ;
      u0 = (long)(IntUZ * rrz);// & 0x3FFFFF;
      v0 = (long)(IntVZ * rrz);// & 0x3FFFFF;
      IntRZ += drzdx_16;
      IntUZ += duzdx_16;
      IntVZ += dvzdx_16;
```

```
      rrz = 1.0f / IntRZ;
      u1 = (long)(IntUZ * rrz);// & 0x3FFFFF;
      v1 = (long)(IntVZ * rrz);// & 0x3FFFFF;
      IntRZ += drzdx_16;
      IntUZ += duzdx_16;
      IntVZ += dvzdx_16;

      static long du,dv,W16;
      static long Counter;

      if (Width>=16)
      {
           W16 = Width>>4;

           // affine-16 inner outer
           do {
                rrz = 1.0f / IntRZ;
                du = (u1-u0)>>4;
                dv = (v1-v0)>>4;
                // affine-16 inner inner
                Counter = 16;
                do {
                     *ScanPtr++ =
RR_TexturePtr[((u0&RR_MaskU)>>16)+((v0&RR_MaskV)>>(16-
RR_Texture._l2xRes))];
                     //*ScanPtr++ += 0x7bef;
                     u0 += du;
                     v0 += dv;
                } while (--Counter);
                u1 = (long)(IntUZ * rrz);
                v1 = (long)(IntVZ * rrz);
                IntRZ += drzdx_16;
                IntUZ += duzdx_16;
                IntVZ += dvzdx_16;
           } while (--W16);
           Width &= 0xF;
           if (!Width) return;
      }

      du = (u1-u0)>>4;
      dv = (v1-v0)>>4;
      do {
           *ScanPtr++ =
RR_TexturePtr[((u0&RR_MaskU)>>16)+((v0&RR_MaskV)>>(16-
RR_Texture._l2xRes))];
           //*ScanPtr++ += 0x7bef;
```

```
            u0 += du;
            v0 += dv;
      } while (--Width);
}

static void RR_OuterLoop_Standard()
{
      static float subX;
      if (!RR_SectionHeight) return;
      do {
            long x0 = (long)ceil(LeftX);
            long x1 = (long)ceil(RightX);
            Width = x1-x0;
            if (Width>0) {
                  ScanPtr = Scanline + x0;
                  subX = x0 - LeftX;
                  IntUZ = LeftUZ + subX * duzdx_;
                  IntVZ = LeftVZ + subX * dvzdx_;
                  IntRZ = LeftRZ + subX * drzdx_;
                  RR_InnerLoop();
            }
            LeftX += LeftDX;
            LeftUZ += LeftDUZ;
            LeftVZ += LeftDVZ;
            LeftRZ += LeftDRZ;
            RightX += RightDX;
            Scanline += g_VS.xRes;
      } while (--RR_SectionHeight);
}



// Interface functions with eyal's mapper
static void RR_OuterInit_Standard()
{
      RRGrads(RR_VA[0],RR_VA[1],RR_VA[2]);
}

#ifndef _FLY_OVER_WIN_CE
static void RR_OuterInit_Interface()
{
      // why the d [1/z,u/z,v/z] / d [x,y] arent identical
across the entire plane..
      // didnt figure...probably has to do with the linear
discontinuities of the mapping
      // coordinates between polygons
```

```
     // Per-polygon delta computation vars
#ifndef HYPERBOLIC_MAPPING
     double divDxy,dxy;
     Vertex *A = RR_VA[0];
     Vertex *B = RR_VA[1];
     Vertex *C = RR_VA[2];
#endif

     txtrstruct.bmp = RR_TexturePtr;
     txtrstruct.scanLinePtr = Scanline;
     txtrstruct.Pitch = g_VS.Pitch;

#ifdef HYPERBOLIC_MAPPING
     txtrstruct.adZ = drzdx;
     txtrstruct.adUZ = duzdx[g_lvldiff];// * RR_TScale;
     txtrstruct.adVZ = dvzdx[g_lvldiff];// * RR_TScale;
#else
     // Per-polygon d/dX computation (required if roll!=0)
     divDxy = ((C->PY-A->PY)*(B->PX-A->PX))-((B->PY-A-
>PY)*(C->PX-A->PX));
     dxy = 1.0 / divDxy;
     txtrstruct.adZ = ((C->PY-A->PY)*(B->RZ-A->RZ)-(B->PY-
A->PY)*(C->RZ-A->RZ)) * dxy;
     dxy *= (TEXTURE_MUL);
     txtrstruct.adUZ = ((C->PY-A->PY)*(B->UZ-A->UZ)-(B->PY-
A->PY)*(C->UZ-A->UZ)) * dxy;
     txtrstruct.adVZ = ((C->PY-A->PY)*(B->VZ-A->VZ)-(B->PY-
A->PY)*(C->VZ-A->VZ)) * dxy;
#endif

#ifdef HYPERBOLIC_MAPPING
     txtrstruct.adZdy = drzdy;
     txtrstruct.adUZdy = duzdy[g_lvldiff];// * RR_TScale;
     txtrstruct.adVZdy = dvzdy[g_lvldiff];// * RR_TScale;
#else
     // Per-polygon d/dY computation (always required)
     divDxy = ((C->PX-A->PX)*(B->PY-A->PY))-((B->PX-A-
>PX)*(C->PY-A->PY));
     dxy = 1.0 / divDxy;
     txtrstruct.adZdy = ((C->PX-A->PX)*(B->RZ-A->RZ)-(B-
>PX-A->PX)*(C->RZ-A->RZ)) * dxy;
     dxy *= (TEXTURE_MUL);
     txtrstruct.adUZdy = ((C->PX-A->PX)*(B->UZ-A->UZ)-(B-
>PX-A->PX)*(C->UZ-A->UZ)) * dxy;
     txtrstruct.adVZdy = ((C->PX-A->PX)*(B->VZ-A->VZ)-(B-
>PX-A->PX)*(C->VZ-A->VZ)) * dxy;
#endif
```

```
}

static void RR_OuterLoop_Interface()
{
     /*
     void *bmp; // Texture Ptr
     word *scanLinePtr; // Pointer to start of first
scanline
     long Pitch; // Pitch (in bytes)
     long leftX,rightX;
     long addXL,addXR;
     long rZ,uZ,vZ;
     dword sectionDelta;

     float u1,v1, // [u1,v1] is the texture coordinate on
the left edge in first scanline
          adZ,adUZ,adVZ, // d[1/Z, U/Z, V/Z] / dx
          adZdy,adUZdy,adVZdy;// d[1/Z, U/Z, V/Z] / dx
     */
     txtrstruct.leftX  = (long) (LeftX * 65536.0);
     txtrstruct.rightX = (long) (RightX * 65536.0);
     txtrstruct.addXL  = (long) (LeftDX * 65536.0);
     txtrstruct.addXR  = (long) (RightDX * 65536.0);
     float subX = (float)ceil(LeftX) - LeftX;
     txtrstruct.uZ = LeftUZ + subX * txtrstruct.adUZ;
     txtrstruct.vZ = LeftVZ + subX * txtrstruct.adVZ;
     txtrstruct.rZ = LeftRZ + subX * txtrstruct.adZ;

     float z = 1.0f / txtrstruct.rZ;
     txtrstruct.u1 = txtrstruct.uZ * z;
     txtrstruct.v1 = txtrstruct.vZ * z;
     txtrstruct.sectionDelta = RR_SectionHeight;

     texture_per64();
}
#else // _FLY_OVER_WIN_CE
static void RR_OuterInit_Interface()
{
}
static void RR_OuterLoop_Interface()
{
}
#endif // _FLY_OVER_WIN_CE


dword RR_Gradients(Vertex *A,Vertex *B,Vertex *C)
{
```

```
	float divDxy = ((C->PY-A->PY)*(B->PX-A->PX))-((B->PY-
A->PY)*(C->PX-A->PX));
	if (divDxy>0.0000001) {
		RR_GPositive = 1;
	} else if (divDxy<-0.0000001) {
		RR_GPositive = 0;
	} else return 1; //Degenerate triangle (colinear
points)
	float dxy = 1.0f / divDxy;
	drzdx_ = ((C->PY-A->PY)*(B->RZ-A->RZ)-(B->PY-A-
>PY)*(C->RZ-A->RZ)) * dxy;
	drzdx_16 = drzdx_ * 16.0f;
	//dxy *= RR_TScale;

	duzdx_ = ((C->PY-A->PY)*(B->UZ-A->UZ)-(B->PY-A-
>PY)*(C->UZ-A->UZ)) * dxy * RR_TScaleU;
	duzdx_16 = duzdx_ * 16.0f;

	dvzdx_ = ((C->PY-A->PY)*(B->VZ-A->VZ)-(B->PY-A-
>PY)*(C->VZ-A->VZ)) * dxy * RR_TScaleV;
	dvzdx_16 = dvzdx_ * 16.0f;


	return 0;
}


void Referance_Rasterizer_Triangle()
{
	// Sort input Vertices by Y coordinate.
	Vertex *A = RR_VA[0],*B = RR_VA[1],*C = RR_VA[2],*T;
	if (A->PY > B->PY) {T=A; A=B; B=T;}
	if (A->PY > C->PY) {T=A; A=C; C=T;}
	if (B->PY > C->PY) {T=B; B=C; C=T;}

	if (RR_Gradients(A,B,C)) return;

	// round down Y coordinates
	long y0 = (long)ceil(A->PY);
	long y1 = (long)ceil(B->PY);
	long y2 = (long)ceil(C->PY);

	float subY; //sub-pixel correction values
	float idy; // inverse dy

	Scanline = (word *)g_VS.FB + y0 * (g_VS.Pitch>>1);
```

```
	// Check for TOP edge
	if (y0==y1)
	{
		// Check for flat polygon
		if (y0==y2) return;

		if (RR_GPositive)
		{
			// Calculate 0-2, 1-2 edge delta values
			RightDX = (C->PX-B->PX)/(C->PY-B->PY);
			idy = 1.0f / (C->PY-A->PY);
			LeftDX = (C->PX-A->PX) * idy;
			LeftDRZ = (C->RZ-A->RZ) * idy;
			//idy *= RR_TScale;
			LeftDUZ = (C->UZ-A->UZ) * idy * RR_TScaleU;
			LeftDVZ = (C->VZ-A->VZ) * idy * RR_TScaleV;

			// section is 0->2|1->2, apply subpixelling
correction
			subY = y0 - A->PY;
			LeftX = A->PX + subY * LeftDX;
			LeftUZ = A->UZ * RR_TScaleU + LeftDUZ *
subY;
			LeftVZ = A->VZ * RR_TScaleV + LeftDVZ *
subY;
			LeftRZ = A->RZ + LeftDRZ * subY;
			RightX = B->PX + (y1 - B->PY) * RightDX;
		} else {
			// Calculate 1-2, 0-2 edge delta values
			RightDX = (C->PX-A->PX)/(C->PY-A->PY);
			idy = 1.0f / (C->PY-B->PY);
			LeftDX = (C->PX-B->PX) * idy;
			LeftDRZ = (C->RZ-B->RZ) * idy;
			//idy *= RR_TScale;
			LeftDUZ = (C->UZ-B->UZ) * idy * RR_TScaleU;
			LeftDVZ = (C->VZ-B->VZ) * idy * RR_TScaleV;

			// section is 1->2|0->2, apply subpixelling
correction
			subY = y1 - B->PY;
			LeftX = B->PX + subY * LeftDX;
			LeftUZ = B->UZ * RR_TScaleU + LeftDUZ *
subY;
			LeftVZ = B->VZ * RR_TScaleV + LeftDVZ *
subY;
			LeftRZ = B->RZ + LeftDRZ * subY;
			RightX = A->PX + (y0 - A->PY) * RightDX;
```

```
        }

        // Jump to position after all preperations for 1-
2 section
        goto Section12;
    }

    // Section 0-1:
    if (RR_GPositive)
    {
        // Calculate 0-2, 0-1 edge delta values
        RightDX = (B->PX-A->PX)/(B->PY-A->PY);
        idy = 1.0f / (C->PY-A->PY);
        LeftDX = (C->PX-A->PX) * idy;
        LeftDRZ = (C->RZ-A->RZ) * idy;
        //idy *= RR_TScale;
        LeftDUZ = (C->UZ-A->UZ) * idy * RR_TScaleU;
        LeftDVZ = (C->VZ-A->VZ) * idy * RR_TScaleV;
    } else {
        // Calculate 0-1, 0-2 edge delta values
        RightDX = (C->PX-A->PX)/(C->PY-A->PY);
        idy = 1.0f / (B->PY-A->PY);
        LeftDX = (B->PX-A->PX) * idy;
        LeftDRZ = (B->RZ-A->RZ) * idy;
        //idy *= RR_TScale;
        LeftDUZ = (B->UZ-A->UZ) * idy * RR_TScaleU;
        LeftDVZ = (B->VZ-A->VZ) * idy * RR_TScaleV;
    }
    // apply subpixelling correction
    subY = y0 - A->PY;
    LeftX = A->PX + subY * LeftDX;
    LeftUZ = A->UZ * RR_TScaleU + LeftDUZ * subY;
    LeftVZ = A->VZ * RR_TScaleV + LeftDVZ * subY;
    LeftRZ = A->RZ + LeftDRZ * subY;
    RightX = A->PX + subY * RightDX;
    RR_SectionHeight = y1-y0;
    RR_OuterLoop();

    subY = y1 - B->PY;

    if (RR_GPositive)
    {
        // Calculate 1-2 edge delta values
        RightDX = (C->PX-B->PX)/(C->PY-B->PY);
        // apply subpixelling correction
        RightX = B->PX + subY * RightDX;
    } else {
```

```
            // Calculate 1-2 edge delta values
            idy = 1.0f / (C->PY - B->PY);
            LeftDX = (C->PX-B->PX) * idy;
            LeftDRZ = (C->RZ-B->RZ) * idy;
            //idy *= RR_TScale;
            LeftDUZ = (C->UZ-B->UZ) * idy * RR_TScaleU;
            LeftDVZ = (C->VZ-B->VZ) * idy * RR_TScaleV;

            // apply subpixelling correction
            LeftX = B->PX + subY * LeftDX;
            LeftUZ = B->UZ * RR_TScaleU + LeftDUZ * subY;
            LeftVZ = B->VZ * RR_TScaleV + LeftDVZ * subY;
            LeftRZ = B->RZ + LeftDRZ * subY;
      }

Section12:;
      RR_SectionHeight = y2-y1;
      RR_OuterLoop();
}

static dword Left,Right,HLeft,HRight;

void RR_GetLeftSection()
{
      long cy = RR_Y[Left],ny;
      do
      {
            if (Left==RR_NumVerts-1) Left=0;
            else ++Left;
            ny = RR_Y[Left];
      } while (ny==cy);
      if (ny<cy) return; // End of polygon
      HLeft = ny-cy;
      float subY = cy - RR_VA[Left-1]->PY;
      float idy = 1.0f / (RR_VA[Left]->PY - RR_VA[Left-1]-
>PY);
      LeftDX = (RR_VA[Left]->PX - RR_VA[Left-1]->PX) * idy;
      LeftDRZ = (RR_VA[Left]->RZ - RR_VA[Left-1]->RZ) * idy;
      //idy *= RR_TScale;
      LeftDUZ = (RR_VA[Left]->UZ - RR_VA[Left-1]->UZ) * idy
* RR_TScaleU;
      LeftDVZ = (RR_VA[Left]->VZ - RR_VA[Left-1]->VZ) * idy
* RR_TScaleV;

      LeftX = RR_VA[Left-1]->PX + LeftDX * subY;
      LeftUZ = RR_VA[Left-1]->UZ * RR_TScaleU + LeftDUZ *
subY;
```

```
     LeftVZ = RR_VA[Left-1]->VZ * RR_TScaleV + LeftDVZ *
subY;
     LeftRZ = RR_VA[Left-1]->RZ + LeftDRZ * subY;
}

void RR_GetRightSection()
{
     long cy = RR_Y[Right],ny;
     do
     {
          if (!Right) Right = RR_NumVerts-1;
          else --Right;
          ny = RR_Y[Right];
     } while (ny==cy);

     HRight = ny-cy;

     RightDX = (RR_VA[Right]->PX - RR_VA[Right+1]->PX) /
(RR_VA[Right]->PY - RR_VA[Right+1]->PY);
     RightX = RR_VA[Right+1]->PX + (cy-RR_VA[Right+1]->PY)
* RightDX;
}

void Referance_Rasterizer_Polygon()
{
     // Calculate Polygon Height
     dword y = ceil(RR_VA[0]->PY);
     dword my = y,My = y,mi = 0,Mi = 0,i;
     RR_Y[0] = y;
     for(i=1;i<RR_NumVerts;++i)
     {
          y = RR_Y[i] = ceil(RR_VA[i]->PY);
          if (y<my) {my = y; mi = i;}
          else if (y>My) {My = y; Mi = i;}
     }
     if (My==my) return; // zero height

     RR_Y[RR_NumVerts] = RR_Y[0];
     RR_Y[-1] = RR_Y[RR_NumVerts-1];

     Left = Right = mi;
     HLeft = HRight = 0;
     Scanline = (word *)g_VS.FB + my * (g_VS.Pitch>>1);

     // Calculate Gradients (this has degenerate cases as
well but are not likely to
     // appear, and gradients are constant anyway)
```

```
      /*if (Mi-mi==1)
           RRGrads(RR_VA[mi],RR_VA[Mi],RR_VA[Mi+1]);
      else
           RRGrads(RR_VA[mi],RR_VA[mi+1],RR_VA[Mi]);*/
      // Use constant Gradients (works!) [not needed using
mapper/interface]
      /*drzdx_ = drzdx;
      drzdx_16 = drzdx_ * 16.0f;
      duzdx_ = duzdx[g_lvldiff];
      duzdx_16 = duzdx_ * 16.0f;
      dvzdx_ = dvzdx[g_lvldiff];
      dvzdx_16 = dvzdx_ * 16.0f;*/

      // Initialize Outer loop function
      RR_OuterInit();
      do
      {
           if (!HLeft) RR_GetLeftSection();
           if (!HLeft) break;
           if (!HRight) RR_GetRightSection();
           if (HLeft < HRight)
           {
                RR_SectionHeight = HLeft;
                HRight -= HLeft;
                HLeft = 0;
           } else {
                RR_SectionHeight = HRight;
                HLeft -= HRight;
                HRight = 0;
           }
           // Execute outer
           RR_OuterLoop();

           if (HLeft)
           {
                LeftX += LeftDX * RR_SectionHeight;
                LeftUZ += LeftDUZ * RR_SectionHeight;
                LeftVZ += LeftDVZ * RR_SectionHeight;
                LeftRZ += LeftDRZ * RR_SectionHeight;
           }
           if (HRight)
           {
                RightX += RightDX * RR_SectionHeight;
           }
      } while (1);
}
```

```
void Referance_Rasterizer(Vertex **VA)
{
     if (RR_TexturePtr == NULL) return;

     dword i,j;

     if (1)//GetAsyncKeyState('R'))
     {
          RR_NumVerts = C_NumVtx;
          memcpy(RR_VA,VA,C_NumVtx*sizeof(Vertex *));
          RR_VA[C_NumVtx] = RR_VA[0];
          RR_VA[-1] = RR_VA[C_NumVtx-1];
          Referance_Rasterizer_Polygon();
     } else {
          RR_VA[0] = VA[0];
          j = C_NumVtx;
          C_NumVtx = 3;
          for(i=2;i<j;++i)
          {
               RR_VA[1] = VA[i-1];
               RR_VA[2] = VA[i];
               //Texture_Mapper(F,RR_VA);
               //Rasterizer(F,RR_VA);
          }
          C_NumVtx = j;
     }
}


// this enables function selection using arrays. faster,
less space consuming, but harder to read.
//typedef void (*RR_OuterInitType)();
//typedef void (*RR_OuterLoopType)();
//RR_OuterInitType RR_OuterInitFunctions[] =
{RR_OuterInit_Standard, RR_OuterInit_Interface};
//RR_OuterLoopType RR_OuterLoopFunctions[] =
{RR_OuterLoop_Standard, RR_OuterLoop_Interface};

void RR_SetTextureMapper(eTextureMappers TM)
{
     switch (TM)
     {
     case TMapper_Standard:
          RR_OuterInit = RR_OuterInit_Standard;
          RR_OuterLoop = RR_OuterLoop_Standard;
          break;
```

```
        case TMapper_Interface:
             RR_OuterInit = RR_OuterInit_Interface;
             RR_OuterLoop = RR_OuterLoop_Interface;
             break;

        }

}

void RR_SetTextureInner(eTextureInners TI)
{
        switch (TI)
        {
        case TInner_Standard:
             RR_InnerLoop = RR_InnerLoop_Standard;
             break;
        case TInner_ZeroColorKey:
             RR_InnerLoop = RR_InnerLoop_ZCK;
             break;
        }
}
```